

AN EXPLORATION OF TENSIONS IN CENTRALIZED AND DECENTRALIZED DIGITAL PLATFORM CONTEXTS

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Submitted by: Tobias Mini, M.Sc.
First Reviewer: Prof. Dr. Thomas Widjaja
Second Reviewer: Prof. Dr. Jin Gerlach

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First Reviewer: Prof. Dr. Thomas Widjaja

Second Reviewer: Prof. Dr. Jin Gerlach

Abstract

Digital platforms consist of technical elements such as software and hardware and associated social elements such as organizational processes and standards. When such social or technical elements seem logical individually but inconsistent when juxtaposed they form tensions. Prior research on platforms often focused on individual elements of digital platforms but neglected possible related and conflicting elements which offers limited insight about underlying tensions. While some studies on platforms considered tensions, they largely assumed that centralized platform owners being responsible for responding to tensions, neglecting collective response mechanisms in blockchain-based decentralized autonomous organizations (DAOs) where decentralized participants typically respond to tensions. The examination of tensions in the context of centralized platforms and decentralized autonomous organizations offers an opportunity to surface conflicting elements that form novel types of socio-technical tensions which require collective and technology-enabled response mechanisms. This thesis explored what tensions exist in centralized and decentralized digital platform contexts and how platform participants can respond to selected tensions. For this purpose, this thesis comprises five essays that employ multiple different research methods including interviews analyzed by using techniques of grounded theory, qualitative meta-analysis of published case studies, and systematic literature reviews. The findings derived from all five essays contribute to a better understanding of tensions in digital platforms. In particular, this thesis (1) offers a lens for analyzing platforms as collective organizations in which tensions arise at the collective meta-organizational level requiring collective responses, (2) identifies new tensions and response mechanisms related to generativity and collectivity, and (3) points to a novel category of socio-technical tensions that are especially salient in digital platforms.

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Introduction

Motivation and Overall Research Aims

Digital platforms are proliferating across the globe where some of the most valuable companies—including Apple, Google, Amazon, Facebook, or Alibaba—are platform organizations (Constantinides et al., 2018). Platforms such as Apple’s iOS are developed and governed by centralized platform owners that typically leverage the unique properties and architecture of digital technologies to align other platform participants such as users or complementors with the platform’s purpose (Constantinides et al., 2018; Tiwana et al., 2010). The separation between the ownership of the platform and platform participation directs attention to the centralized platform owner being responsible for responding to tensions related to developing and governing digital platforms (Cennamo & Santaló, 2019; Gregory et al., 2015; Huber et al., 2017; Tilson et al., 2010; Tilson et al., 2021; Wareham et al., 2014; Yoo et al., 2012). For instance, a key tension to which platform owners typically respond is to appropriately bound participant behavior without excessively constraining the generativity of the technology by which platform participants can create services, applications, or content for the platform in unexpected ways (Brunswick & Schecter, 2019; Cennamo & Santaló, 2019; Tilson et al., 2010). Since such tensions often not only affect the centralized platform owner, but also other platform participants such as platform complementors or users (e.g., Brunswick & Schecter, 2019; Eaton et al., 2015) or the collective meta-organization (Cennamo & Santaló, 2019; Faraj et al., 2011), the need for collective responses to tensions arises. Such collective responses to tensions can particularly be observed in decentralized platform contexts such as in blockchain-based decentralized autonomous organizations (DAOs) in which decentralized participants (partly) own the DAO and have to collectively respond to tensions related to collective action (Chen et al., 2021; Lumineau et al., 2021; Rozas et al., 2021). For example, MakerDAO, recognized as one of the most successful and mature DAOs, involves a community of MKR token holders who collectively own the DAO and make decisions, facing the tension to make sustained contributions to the DAO while earning financial rewards (MakerDAO, 2017).

Previous research highlights that digital platforms consist of technical elements such as software and hardware and associated social elements such as organizational processes and standards (de Reuver et al., 2018). When such social or technical elements seem logical individually but inconsistent when juxtaposed they form tensions (Lewis, 2000; Smith & Lewis, 2011). Substantial empirical and theoretical work exists especially in organizational and management research that has explored contradictory yet interrelated social elements that spur tensions related to organizing, performing, learning, or belonging (e.g., Andriopoulos & Lewis, 2009; Jay, 2013; Lewis, 2000; Luscher & Lewis, 2008; Smith & Lewis, 2011; Smith, 2014; Smith & Tushman, 2005). The

amalgamation of the social and the technical in digital platforms points to the need to incorporate not only social but also technical elements into research on tensions on which recent Information Systems research has started to shed light on (e.g., Gregory et al., 2015; Huber et al., 2017; Tilson et al., 2010; Tilson et al., 2021). While these research areas share notable similarities, the literature streams have evolved largely separately when studying tensions which limits our ability to understand underlying mechanisms and dynamics.

The examination of tensions in centralized and decentralized digital platform contexts offers an opportunity to surface conflicting elements that form novel types of socio-technical tensions which require collective and technology-enabled response mechanisms. While existing research enriched our understanding of certain elements of centralized digital platforms and DAOs, such as architecture and governance (e.g., Chen et al., 2021; Constantinides et al., 2018; Tiwana et al., 2010), these studies often neglected possible related and conflicting elements which offers limited insight into what the underlying tensions are. Nevertheless, while some studies in the digital platform context explicitly considered tensions (e.g., Cennamo & Santaló, 2019; Gregory et al., 2015; Huber et al., 2017; Tilson et al., 2010; Tilson et al., 2021; Wareham et al., 2014), these studies largely assumed that centralized platform owners can respond to tensions which limits our understanding of collective response mechanisms. Therefore, it is important to first become aware of tensions that surface in centralized and decentralized digital platform contexts and thereafter consider mechanisms to effectively respond to them which leads to the following overall research question of this thesis: *What tensions surface in centralized and decentralized digital platform contexts and how can platform participants respond to selected tensions?*

To answer this research question, this thesis comprises five essays that employ multiple different research methods including interviews analyzed by using techniques of grounded theory, qualitative meta-analysis of published case studies, and systematic literature reviews. The findings derived from all five essays contribute to a better understanding of tensions in digital platforms. In particular, this thesis (1) offers a lens for analyzing platforms as collective organizations in which tensions arise at the collective meta-organizational level requiring collective responses, (2) identifies new tensions and response mechanisms related to generativity and collectivity, and (3) points to a novel category of socio-technical tensions that are especially salient in the context of digital platforms.

Conceptual Foundations

Digital Platforms

Prior research largely studied digital platforms from three theoretical perspectives: economic, engineering, and organizational (Gawer, 2014). First, from an economic perspective, digital platforms can be viewed as two- or multi-sided markets (Eisenmann et al., 2006; Evans, 2003;

Evans & Schmalensee, 2007; Rochet & Tirole, 2003) which involve “groups of agents who interact via ‘platforms,’ where one group's benefit from joining a platform depends on the size of the other group that joins the platform” (Armstrong, 2006, p. 668). Especially emphasized in the economic perspective on platforms are pricing and (cross-side) network effects (i.e., increasing the number of users on one side of the platform makes it more valuable to the users on the other side) (e.g., Armstrong, 2006; Eisenmann et al., 2006; Rochet & Tirole, 2003; Rochet & Tirole, 2006). While research that studied platforms from an economic perspective made important contributions, platform participants are often treated simply as consumers that interact over a platform that is assumed to be exogenous and fixed which limits our understanding on how platforms should be developed or governed (Gawer, 2014).

Second, the engineering design literature started by examining product platforms and how these can be integrated into product families (Gawer, 2014). Early researchers viewed the platform as a bundle of standard components or functions that form a general-purpose technology with an integrated architecture and standards as the basis for third-party developers to develop complementary assets (Bresnahan & Greenstein, 1999; Fichman, 2004; Gawer & Cusumano, 2008; Taudes et al., 2000; West, 2003). What these early platform conceptualizations have in common is their focus on architecture and more specifically on modular technological architecture (Gawer, 2014). In line with these early conceptualizations and by taking the unique properties of digital technologies into account (Yoo et al., 2010), digital platforms can be seen as layered-modular technological architectures with stable core components and variable peripheral components (Baldwin & Woodard, 2009; Tiwana et al., 2010). The core of a digital platform consists of “the extensible codebase of a software-based system that provides core functionality” (Tiwana et al., 2010, p. 675). Boudreau (2010) further states that especially technical standards support interoperability among the modules on the periphery. The engineering perspective stresses the importance of platforms to be generative, i.e., the “capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences” (Zittrain, 2008, p. 70). While the engineering perspective is particularly useful to understand how platforms stimulate generative innovation, it often does not take into account how multiple actors organize and coordinate themselves on the platform (Gawer, 2014).

Third, the organizational perspective also conceptualizes platforms as consisting of a modular architecture but by highlighting the value-creating interactions between (internal and external) actors and resources (Constantinides et al., 2018; Gawer, 2014; Rolland et al., 2018). This perspective views a platform as a meta-organization (Ciborra, 1996; Gawer, 2014; Kretschmer et al., 2022; McIntyre et al., 2021) defined as “networks of firms or individuals not bound by authority based on employment relationships, but characterized by a system-level goal” (Gulati et al., 2012, p. 573). Gawer (2014) characterizes these evolving platform organizations or meta-organizations

by three aspects: (1) the coordination of actors (which can be both individuals or firms and which can take different roles); (2) economies of scope in both supply and/or demand; and (3) a modular technological architecture with a core and peripheral components. In other words, digital platforms consist of technical elements along with organizational processes and standards (de Reuver et al., 2018). In this thesis the organizational perspective on platforms is adopted, as it provides an integrated view on economic, engineering, and organizational aspects of digital platforms (Gawer, 2014). Accordingly, digital platforms can be defined as meta-organizations that entail a layered-modular technological architecture, comprise of a market with multiple sides, and enable the orchestration of value-creating interactions between multiple actors (Constantinides et al., 2018; de Reuver et al., 2018; Gawer, 2014; Tiwana et al., 2010; Yoo et al., 2010). Whereas the engineering perspective forefronts platform generativity and the economic perspective has similar strong connotations by emphasizing pricing and network effects, the organizational perspective takes the position that digital platforms are not unlimitedly generative (Rolland et al., 2018). Hence, especially emphasized in the organizational perspective are mechanisms that appropriately bound participant behavior without excessively constraining the desired level of generativity of the platform which often creates tensions related to generativity (Cennamo & Santaló, 2019; Moehlmann et al., 2021).

Decentralized Autonomous Organizations

Decentralized autonomous organizations (DAOs) (Beck et al., 2018; Chen et al., 2021; Hsieh et al., 2018; Lumineau et al., 2021; Murray et al., 2021; Vergne, 2020) promise new forms of decentralized meta-organizing (Gulati et al., 2012; Puranam et al., 2014) as alternatives to platforms orchestrated by a dominant platform owner (Constantinides et al., 2018; Tiwana et al., 2010). Many DAOs can be seen as platforms in that they enable value-creating interactions between multiple actors (Constantinides et al., 2018). For example, MakerDAO is a smart-contract service built on the Ethereum blockchain, allowing lending and borrowing of cryptocurrencies without the need for a middleman (MakerDAO, 2017). A DAO involves a distributed network of autonomous human or organizational actors who align around a common overall purpose through algorithms in the form of smart contracts deployed on a blockchain, and a shared constitution or set of rules and processes for operating and changing the network (Beck et al., 2018; Buterin, 2014a; De Filippi & Wright, 2018; Hassan & De Filippi, 2021; Murray et al., 2021; Voshmgir, 2020). DAOs hold the promise to be production communities that are collectively owned by their members whose governance is decentralized, that is, independent from central control, by relying on a set of self-executing rules deployed on a public blockchain with the goal of achieving collective outcomes (Beck et al., 2018; Chen et al., 2021; Hassan & De Filippi, 2021; Lumineau et al., 2021; O'Mahony & Ferraro, 2007; Rozas et al., 2021). At the core of what makes DAOs as a form of organizing so unique compared to centrally governed organizations is the idea of collective ownership, which establishes skin in the game (Taleb, 2018) in which risks and rewards are more equally shared

among all DAO participants and thus creates sustained incentives for every participant to invest themselves and help further the DAO's goals and purpose. DAOs establish collective ownership by combining at least three key developments: the deployment of smart contracts on a blockchain architecture, the introduction of digital tokens, and leadership by a decentralized community (Beck et al., 2018; Cennamo et al., 2020; Chen et al., 2021; Lumineau et al., 2021; Murray et al., 2021). First, the evolution of digital technology gives rise to smart contracts that can be deployed on peer-to-peer blockchain networks. A blockchain refers to a distributed ledger and database that can record transactions between actors in a peer-to-peer (P2P) network drawing on consensus algorithms for verification (Beck et al., 2018; Lumineau et al., 2021; Nakamoto, 2008). The first blockchain was outlined in 2008 in a white paper by Satoshi Nakamoto, a pseudonymous person or group, and was called 'Bitcoin' describing the vision of a P2P payment system where online payments could be sent directly to each other without the need for a central financial institution that controls payment processing, i.e., in a fully decentralized way (Nakamoto, 2008). Decentralization refers to transferring control and decision-making from a centralized entity, i.e., an organization, government, or company, to a distributed network of actors (Chen et al., 2021). With Bitcoin's launch in early 2009 and subsequent growth toward becoming more accepted as a payment system, programmers began to explore the blockchain technology for uses outside of just digital currencies (Andersen & Bogusz, 2019; Beck et al., 2018; De Filippi & Wright, 2018). A few years after the appearance of Bitcoin, the concept of a decentralized autonomous corporation (DAC) was conceived (Buterin, 2014a). Viewed as a new corporate governance form using tokenized tradable shares as a means of providing dividends to shareholders, the term was soon considered too restrictive as it did not account for the emergence of decentralized applications (dapps) on blockchain networks. Eventually, the term decentralized autonomous organization (DAO) established itself in the context of the rise of smart contracts and the Ethereum blockchain (Hassan & De Filippi, 2021). Perhaps the most significant generalization over purely financial-oriented blockchains such as Bitcoin was envisioned in 2014 in a white paper by Vitalik Buterin, who introduced the Ethereum blockchain with the key idea of deploying so-called "smart contracts" on a blockchain (Buterin, 2014b). Smart contracts refer to agreements codified in software that automatically execute when pre-specified conditions are met resulting in algorithmic enforcement (Beck et al., 2018; Buterin, 2014b; Lumineau et al., 2021; Murray et al., 2021; Szabo, 1996; Szabo, 1997; Werbach & Cornell, 2017). In the same Ethereum white paper, Vitalik Buterin outlined the idea of using smart contracts to encode the bylaws of entire organizations, so-called DAOs (Buterin, 2014b). Through their ability to algorithmically enforce agreements, smart contracts running on peer-to-peer blockchain networks play a foundational role for DAOs to emerge as a form of organizing.

Second, the design and use of cryptographic assets or tokens—scarce and valuable digital representations of unique rights—is another key development that establishes collective ownership

in DAOs (Cennamo et al., 2020; Hsieh et al., 2018; Oliveira et al., 2018; Schirmacher et al., 2021). Digital tokens can represent anything from a store of economic value to a set of permissions in the physical or digital world and can be used to reward certain activities in a DAO (Buterin, 2014a; Voshmgir, 2020). Potential contributors or investors in a DAO can exchange other digital cryptocurrencies or tokens for the DAOs native tokens to gain an ownership stake in a DAOs internal capital (Buterin, 2014a; De Filippi & Wright, 2018). Members of DAOs are also (in part) the owners of the DAO and decide in a decentralized way on important decisions such as how the rules and logic should be encoded in the smart contracts and how the organization should allocate its funds that represent the internal capital in the form of digital tokens (Buterin, 2014a). Voting rights to participate in decision-making are often issued in accordance with the stake (in terms of tokens) that the actors in the distributed network hold on a DAO (Voshmgir, 2020). Digital tokens as valuable assets that can be traded and invested to earn rewards or be used for governance decisions provide another key development that establishes DAOs as a new form of organizing.

The third development that gives rise to collective ownership in DAOs are the voluntary contributions of their community as an evolution of voluntary participation known from open-source projects (Benkler, 2006). Distributed participants in a DAO can take on leadership roles in accordance with their interests to bring decentralization to more performance-enhancing levels (Chen et al., 2021; O'Mahony & Ferraro, 2007; O'Mahony & Karp, 2022; von Hippel & von Krogh, 2003). In DAOs, governance rights are distributed to the collective where those affected by platform rules typically can participate in their making (Chen et al., 2021; O'Mahony & Karp, 2022). DAOs build upon and extend this persistent trend of voluntary participation in open-source production communities (O'Mahony & Ferraro, 2007) by providing direct economic incentives through token rewards and by relying on both collective intelligence and smart contracts to self-govern at greater scale.

Tensions and Response Mechanisms in the Era of Digital Platforms and DAOs

To analyze and explore what tensions surface in centralized and decentralized digital platform contexts and how platform participants can respond to selected tensions, this thesis draws on the theoretical lens of tensions (Lewis, 2000; Smith & Lewis, 2011). Tensions arise when elements seem logical individually but inconsistent when juxtaposed (Smith & Lewis, 2011) and signify two sides of the same coin (Lewis, 2000). For example, the Taoist symbol of Yin and Yang—in which both elements contain a part of the other and inform each other—is often used to symbolize tensions. Choices made between the elements of a tension can lead to stress, anxiety, discomfort, or tightness in humans (Putnam et al., 2016). Choosing one element of a tension to the detriment of the other (i.e., making an either/or choice) can lead to vicious cycles in which anxiety may temporarily be reduced, but the tension eventually be intensified (Lewis, 2000). Awareness of

tensions, on the other hand, can trigger active responses of accepting, working through, and balancing tensions (i.e., finding a both/and synthesis) that can lead to virtuous cycles and a dynamic equilibrium (Lewis, 2000; Luscher & Lewis, 2008; Miron-Spektor et al., 2018; Putnam et al., 2016; Smith & Lewis, 2011). Such active attempts to explore tensions and thereby tap the potential energy, insights, and power of tensions (Lewis, 2000; Smith & Lewis, 2011) are considered as mechanisms (Bunge, 2004) to respond to tensions in this thesis.

Prior research on tensions identified four interrelated tension categories: (1) organizing tensions surface when complex organizational systems create competing designs and processes; (2) performing tensions arise when a plurality of actors seek conflicting goals; (3) learning tensions involve using and often destroying past practices to create new ones; and (4) belonging tensions stem from competing identities with which individuals identify with (Lewis, 2000; Luscher & Lewis, 2008; Smith & Lewis, 2011). While substantial empirical and theoretical work exists especially in management and organizational research that has explored tensions operating between as well as within these four categories (e.g., Andriopoulos & Lewis, 2009; Jay, 2013; Lewis, 2000; Luscher & Lewis, 2008; Smith & Lewis, 2011; Smith, 2014; Smith & Tushman, 2005), the social and the technical elements of digital platforms have been incorporated to a lesser extent into research on tensions (Tilson et al., 2010; Tilson et al., 2021; Yoo et al., 2012). A line of research especially in Information Systems has already started to explore tensions in digital platforms (e.g., Ghazawneh & Henfridsson, 2013; Gregory et al., 2015; Huber et al., 2017; Tilson et al., 2021; Wareham et al., 2014; Yoo et al., 2012) highlighting key tensions related to generativity (e.g., Brunswicker & Schechter, 2019; Cennamo & Santaló, 2019; Eaton et al., 2015; Tilson et al., 2010). However, these studies typically assume that centralized platform owners have the power and agency to respond to tensions, but considered to a lesser extent how individual platform participants such as platform complementors or users (e.g., Brunswicker & Schechter, 2019; Eaton et al., 2015) or the collective meta-organization (Cennamo & Santaló, 2019; Faraj et al., 2011) can respond to tensions. While these studies made important contributions by identifying response mechanisms for tensions related to generativity and other aspects of digital platforms, our understanding of tensions related to collectivity that can be observed in blockchain-based decentralized autonomous organizations (Chen et al., 2021; Lumineau et al., 2021; Rozas et al., 2021) is still limited. These limitations of prior research invite an investigation of tensions in centralized and decentralized digital platform contexts.

Research Methods

To answer the research question of what tensions surface in centralized and decentralized digital platform contexts and how platform participants can respond to selected tensions, different research methods were employed in this thesis. These research methods included interviews analyzed by

using techniques of grounded theory, qualitative meta-analysis of published case studies, and (systematic) literature reviews. Numerous smaller literature reviews were conducted in this thesis to conceptualize digital platforms and tensions (in essay 1), platform organizing (in essay 2), platform development (in essay 3), and decentralized autonomous organizations and platform governance (in essays 4 and 5). A comprehensive systematic literature review was conducted in the first essay by following the recommendations of Webster and Watson (2002) and vom Brocke et al. (2015) which had the purpose to get an overview of tensions in digital platforms. This literature review included a systematic search in the Senior Scholars' Basket of Journals of the Association for Information Systems and a backward search that broadened the search to other outlets outside the Information Systems discipline which resulted in 147 obtained studies. These studies were filtered based on title and abstract screening and reviewing of full texts resulting in a final literature set of 26 studies. The identified tensions in digital platforms were classified into an analytical framework.

Based on the analytical framework for tensions in digital platforms obtained from the literature review in essay 1, a key tension related to generativity which is particularly salient in platform governance, the tension between autonomy and alignment, was identified which formed the basis of the second essay. In essay 2, a qualitative meta-analysis (Noblit & Hare, 1988) of 16 case studies was conducted similar to Berente et al. (2019). The goal of qualitative meta-analysis is to translate constructs from different case studies into each other by reinterpreting existing case studies beyond the original authors interpretations (in contrast to methods that merely aggregate findings such as systematic literature reviews) and to articulate theoretically generalizable findings attentive to the context of each individual case study (Berente et al., 2019; Noblit & Hare, 1988). The 16 case studies in the sample were analyzed using a semi-open coding procedure in order to identify mechanisms, i.e., a set of unique processes in a system that work together to drive outcomes (Bunge, 2004), from the findings of existing case studies that achieve autonomy and alignment in platform meta-organizations.

In the third essay, based on the analytical framework for tensions in digital platforms developed in essay 1 another key tension related to generativity which is particularly salient in platform development, the tension between technological and market demands, was identified. It became clear as the phenomenon of tensions in digital platforms became more studied in this thesis that the depth of a well-chosen single case and the identification of some 'real' processes and mechanisms (Eisenhardt, 1989; Yin, 2009) (in contrast to interpretive approaches which are linked with qualitative meta-analyses) could be a more significant contribution. Therefore, the case of an ideation platform development project in which multiple companies formed a strategic alliance with the common objective to develop a digital ideation platform was studied in essay 3 by collecting primary data including 10 semi-structured interviews with key stakeholders. In this third

essay, techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Glaser & Strauss, 1967; Urquhart, 2013) were used to analyze the case material (comprising 123 pages) in order to identify mechanisms that explain how multiple platform owners can reconcile both technological and market demands when jointly developing a digital platform.

While essays 1, 2, and 3 assumed that single or multiple platform owners (see Figure 1) largely respond to tensions, in the fourth essay an alternative form of platform organizing, decentralized autonomous organizations, was recognized that offered the opportunity to study collective responses to tensions. In essay 4, a multiple-case study of five extreme cases (Gerring, 2006) of DAOs (i.e., Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO) was conducted which were theoretically sampled (Charmaz, 2006) from an initial sample of 20 DAO cases. Secondary data including white papers, blog entries, and newspaper articles was collected since this material provides rich and holistic descriptions of real DAOs, often dives deeper into technological underpinnings of DAOs, and hears different people's voices (e.g., founders, developers of the technology, or token holders). Overall, 257 pages of case material was collected and analyzed using techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Glaser & Strauss, 1967; Urquhart, 2013) to derive mechanisms that explain how DAOs are governed via IT.

The case material from essay 4 was significantly expanded in essay 5 in which additional archival data including white papers, blog articles, podcast interviews, and technical documentation of DAOs (1,055 pages collected) was added. In addition, comprehensive archival data of MakerDAO's evolution such as archival video material of 182 governance and risk meetings, 21 blog articles¹, and 6 Maker Improvement Proposals² as well as primary data in the form of 15 semi-structured interviews with core MakerDAO participants (including core unit team members, governance facilitators, and vote delegates) was collected. These interviews were complemented with observation and detailed analysis of MakerDAO participants at 20 governance and risk meetings (~ 20 hours of observation and writing of field notes) as well as informal dialogue with core participants from MakerDAO over Discord over a four-month period and semi-structured interviews with participants from other DAOs such as ElasticDAO, BanklessDAO, and CommonsStack. In essay 5, techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Glaser & Strauss, 1967; Urquhart, 2013) were used to analyze the case material in order to identify mechanisms that explain how and why decentralized governance as implemented in DAOs facilitates collective action.

¹ <https://forum.makerdao.com>

² <https://mips.makerdao.com/mips/list>

Summaries of the Five Essays and How They Are Related

This thesis comprises five essays of which four have been published in or submitted to double-blind, peer reviewed journals or (ranked) conference proceedings and one is a working paper. See Figure 1 for a classification of the five essays according to the platform context (i.e., centralized or decentralized) and platform elements (i.e., social or technical) that were derived based on emergent findings throughout this thesis.

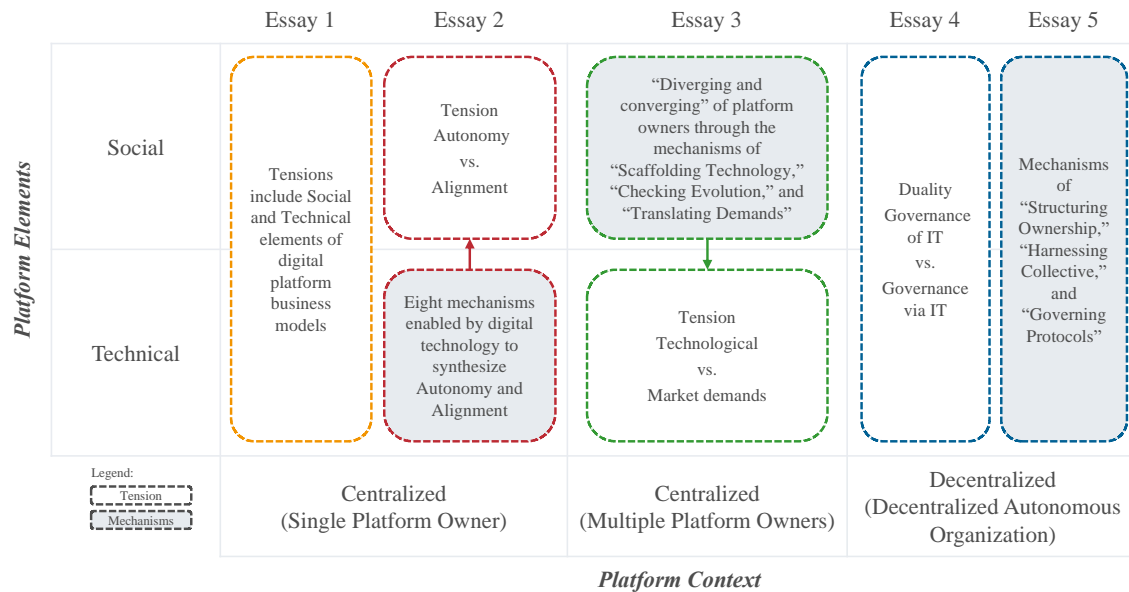


Figure 1. Classification of the essays in the thesis according to the platform context and platform elements

The **first essay** “Tensions in Digital Platform Business Models: A Literature Review” (see Mini & Widjaja, 2019), was co-authored with Thomas Widjaja and was published in the *Proceedings of the 40th International Conference on Information Systems* (VHB-JOURQUAL3 (JQ3)³ ranking: A). This essay examines in a centralized platform context what tensions platform owners face when they manage their digital platform business model and finds that these tensions often include social elements (e.g., control of organizational actors) and technical elements (e.g., generativity of the technical architecture) of digital platform business models (see Figure 1).

A digital platform business model to create, deliver, and capture value consists of conflicting elements that often create tensions (Al-Debei & Avison, 2010; Smith & Lewis, 2011; Teece, 2010). In this essay, the tension and business model perspectives are integrated for the exploration of tensions in digital platform business models. Prior research on platforms often considered specific elements of digital platform business models in isolation, neglecting possible related and

³ The VHB-JOURQUAL ranking is provided by the German Academic Association for Business Research (VHB) and is currently available in version JQ3. It can be viewed online at <https://vhbonline.org/en/vhb4you/vhb-jourqual/vhb-jourqual-3>.

conflicting elements. Especially platform owners face tensions when they want to manage their digital platform business model and play a significant role in the management of tensions which is especially challenging because digital platforms are evolving and generative (Tiwana et al., 2010). While the focus of this essay is on the platform owner it is acknowledged that platform owners often have limited agency when responding to tensions which often also affect other ecosystem actors. In summary, a coherent understanding about what these tensions are and how they interrelate is missing which motivates the following research question of this essay: *What set of interrelated tensions do platform owners face when continuously designing, adapting, and/or redesigning their digital platform business model?*

Based on a systematic literature review of 26 articles in existing digital platform research, 21 unique tensions that platform owners face when crafting business models were identified. These tensions were classified into four different categories of tensions (i.e., organizing, performing, learning, and belonging) based on Smith and Lewis (2011) and into four distinct business model dimensions (i.e., value architecture, value network, value finance, and value proposition) based on Al-Debei and Avison (2010). The findings show that all four business model dimensions (Al-Debei & Avison, 2010) are affected by tensions. In particular, when platform owners aim to manage tensions regarding the tension categories of learning and performing (Smith & Lewis, 2011), they should consider all four business model dimensions (i.e., value architecture, value network, value finance, and value proposition). When platform owners aim to manage tensions regarding organizing and belonging (Smith & Lewis, 2011), the focus should be on the value architecture and value network dimensions. In addition, most tensions can be found on the value architecture and value network dimensions (Al-Debei & Avison, 2010) of the digital platform business model and these two business model dimensions accommodate all four categories of tensions (i.e., learning, belonging, organizing, and performing based on Smith and Lewis (2011)). This finding implicates that perhaps new categories of tensions emerge, especially across and within the value architecture and value network dimensions. Finally, the findings reveal chains of tensions that cross different business model dimensions and cycles of tensions that arise when multiple tension elements are connected within or across different categories of tensions (Smith & Lewis, 2011) and business model dimensions (Al-Debei & Avison, 2010) but form a closed sequence.

The **second essay** “Autonomy and Alignment in Platform-based Meta-organizations: A Qualitative Meta-analysis” (see Mini et al., 2020), co-authored with Thomas Widjaja and Robert W. Gregory, is a working paper and was submitted to the *1st AIS SIG DITE Paper Development Workshop*. As Figure 1 shows, this essay assumes a centralized platform context and examines the social platform elements autonomy and alignment of actors (i.e., individuals or organizations) that spur a tension. The findings reveal eight mechanisms enabled by digital technology.

Meta-organizations leverage the unique properties and architecture of digital technologies to solve the key tension of organizing between autonomy and alignment within distributed networks of autonomous actors without relying on formal contractual or managerial authority while at the same time ensuring alignment with system-level goals (Gulati et al., 2012). Autonomy is defined in the essay as the practical capacities of individual actors to create more value for and by themselves, and in loose commonality with others (Benkler, 2006). Alignment is defined as the federation and coordination of actors distributed across the platform network to ensure ecosystem-wide optimal matching of supply and demand, desirable innovation, or behavioral congruence with the economic vision and cultural expectations set by the platform owner and its direct participants (Gawer, 2014). Meta-organizations are distinct from traditional organizations in that meta-organizations exhibit higher potential for leveraging the autonomy and capacities of actors in the distributed network of the platform for value co-creation, relational architectures are non-hierarchical, and meta-organizations leverage the advancements in the evolution of digital technology (Yoo et al., 2010), including but not limited to the layered-modular architecture that distinguishes between a core and a periphery (Gawer, 2014). These characteristics highlighted above that set meta-organizations apart from traditional organizations motivate the following research question of the essay: *What are the key mechanisms enabled by digital technology for synthesizing autonomy and alignment in non-hierarchical meta-organizations?*

For this purpose, a qualitative meta-analysis of 16 case studies on platform-based meta-organizations published in Information Systems was employed. Eight mechanisms enabled by digital technology were identified that synthesize autonomy and alignment in non-hierarchical meta-organizations. The identified mechanisms were classified into an a-priori derived framework consisting of two dimensions: (1) autonomy that can be taken for granted or granted by the owner of the platform-based meta-organization; and (2) alignment that can be core-driven or periphery-driven. Mechanisms where autonomy was taken for granted and alignment was core-driven were “Values Promoted by the Platform Owner,” “Standards for Participation,” and “Standardized Access to Knowledge for Participation.” Where autonomy was granted by owners and alignment was core-driven, mechanisms of “Standards for Constrained Participation” and “Guided Access to Knowledge for Participation” were identified. The mechanism of “Guided Matching” was found for autonomy that is granted by the platform owner and alignment that is periphery-driven. Finally, taken for granted autonomy and periphery-driven alignment involved the mechanisms of “Social Feedback” and “Free-market Matching.” The preliminary findings are expected to contribute to the literatures on new forms of organizing and platform-based meta-organizations.

The **third essay** with the title “The Diverging and Converging of Multiple Partners in Digital Platform Development” (see Mini, 2022) is a single author paper and has been submitted to the *43rd International Conference on Information Systems* (VHB-JQ3 ranking: A) where it is currently

under review. This essay is located in the platform context of centralized platforms with multiple platform owners that jointly develop a digital platform (see Figure 1). The tension between technological and market demands related to the development of the technological platform core is examined and a dynamic of “diverging and converging” of the multiple platform owner organizations is observed that involves the mechanisms of “scaffolding technology,” “checking evolution,” and “translating demands” (see Figure 1).

Firms or individuals that want to develop a digital platform to become “platform owners” have to meet both technological and market demands that often contradict each other (Qiu et al., 2017) and that are highly uncertain (Dattée et al., 2018). Individual firms often can only meet either technological or market demands, but not both, when developing a digital platform (Murthy & Madhok, 2021; Shi et al., 2021). This essay examines the phenomenon of individual firms that pool their resources and skills with other firms in a strategic alliance to meet both technological and market demands at the same time when jointly developing a digital platform. This joint platform development challenges assumptions of prior research on information systems (IS) development in the context of platforms in that (1) prospective platform owners that develop a digital platform are not only technology providers and market-makers but also orchestrators that connect with multiple partners, (2) platform development is not only a software engineering process but also entails the creation of a larger digital ecosystem, and (3) approaches aimed at reconciling technological and market demands in platform development typically span firm boundaries. Motivated by these challenged assumptions associated with platform development, this third essay addresses the following research question: *How can multiple platform owners reconcile both technological and market demands when jointly developing a digital platform?*

Based on a case study where a firm specialized on software development (i.e., TechnologyCompany) formed a strategic alliance with three other firms that had expertise in innovation management (i.e., PartnerCompanies) with the common objective to develop a digital ideation platform, ten key stakeholders of the ideation platform development project were interviewed and the case material was analyzed using techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Glaser & Strauss, 1967; Urquhart, 2013). The findings from the case study reveal that the platform owner firms in the strategic alliance dynamically “diverge and converge” when they coordinate the platform development between and within their firms. The partners diverge through the mechanism of “scaffolding technology” where features of the platform were developed that may be needed in the future to tackle high uncertainty and to reduce future effort in platform development. This mechanism is counterbalanced by “checking evolution” where feedback on platform features is gathered from potential users to steer the general direction of the platform. The partners converge through the mechanism of “translating demands” where the actors constantly align themselves and create a common understanding for technological

and market demands of the platform. The dynamic of “diverging and converging” between the platform owner firms identified in this paper explains how multiple platform owners can collaborate (Furr & Shipilov, 2018; Jacobides et al., 2018; Shipilov & Gawer, 2020) to reconcile technological and market demands when developing a digital platform (Qiu et al., 2017; Tan et al., 2015).

The **fourth essay** “An Exploration of Governing via IT in Decentralized Autonomous Organizations” (see Mini et al., 2021), co-authored with Eleunthia Wong Ellinger, Robert W. Gregory, and Thomas Widjaja and published in the *Proceedings of the 42nd International Conference on Information Systems* (VHB-JQ3 ranking: A), was nominated for the “Best Theory Development Paper Award” at the 42nd International Conference on Information Systems. In this essay, the platform context of decentralized autonomous organizations is examined and a tension is identified that involves socio-technical platform elements (see Figure 1).

This second essay examines the shift from governance of IT toward governance via IT through platform-based and technology-enabled mechanisms for governance that is underlying the DAO phenomenon, on which previous IT governance research in the context of digital transformation has started to shed light on (Gregory et al., 2018). Governance in DAOs includes complex combinations of community-driven human and algorithmic mechanisms to ensure the alignment of autonomous actors with a shared purpose (Murray et al., 2021). Motivated by the fact that the shift toward governance via IT in DAOs challenges established assumptions of traditional IT governance literature and instead assumes heavy reliance on governance via IT, decentralization of decision-making, and the transparent and automated enforcement of rules, this essay seeks to address the following research question: *How are decentralized autonomous organizations governed via IT?*

To answer this research question, five cases of DAOs (Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO) were analyzed based on white papers, blog entries, and newspaper articles using techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Glaser & Strauss, 1967; Urquhart, 2013). The core finding of this essay is that governing DAOs via IT requires two mechanisms called “establishing algorithmic organization” and “taming algorithmic power.” The first mechanism, “establishing algorithmic organization,” refers to the reinforcement of the software protocol’s central authority in the DAO through ongoing execution of routines. The second mechanism, “taming algorithmic power,” describes how humans both systematically and spontaneously perform actions to bend automated processes in the DAO to comply with their organizational will. The findings implicate that DAOs governed via IT synthesize autonomy and alignment through “establishing algorithmic organization.” At the same time, governance of IT in DAOs involves a more pluralistic and decentralized form of algorithmic management through “taming algorithmic power.” Thus, governance in DAOs involves combining governance via IT, through the mechanism of “establishing algorithmic organization,” with

governance of IT, through the mechanism of “taming algorithmic power,” into a duality (Farjoun, 2010) which points to a fundamental novel tension in blockchain governance that must be resolved for effective governance in DAOs, the tension between governance via IT and governance of IT.

The **fifth essay** “Skin in the Game in DAO Governance: A Dynamic Model of Collective Platform Ownership” (see Ellinger et al., 2022), co-authored with Eleunthia Wong Ellinger, Robert W. Gregory, Thomas Widjaja, and Ola Henfridsson, has been revised and resubmitted to the journal *MIS Quarterly* (VHB-JQ3 ranking: A+). In this essay, the platform context of decentralized autonomous organizations is examined and socio-technical mechanisms are derived (see Figure 1).

Prior research on platforms typically examines centralized forms of governance, where the platform owner develops the governance framework that controls the value-creating interactions on the platform. The concentration of ownership typically limits and constrains the potential for collective action among platform participants. In contrast, DAOs create and sustain themselves through collective action defined as voluntary cooperative behavior among rational, self-interested individuals with common interests (Olson, 1965; Ostrom, 2000). The examination of governance in DAOs offers an opportunity to generate insights about the role of collective ownership for platform governance. Informed by polycentric commons theory (Mindel et al., 2018; Ostrom, 1990) and intended to contribute to platform governance literature (Constantinides et al., 2018; Tiwana et al., 2010), this essay seeks to address the following research question: *How and why does decentralized governance as implemented in DAOs facilitate collective action?*

For this purpose, multiple DAOs were studied with a focus on MakerDAO grounded in rigorous case analysis (Birks et al., 2013; Gerring, 2006). DAOs manifest governance where many platform participants have skin in the game (Taleb, 2018) based on collective ownership by holding governance tokens that give them a voice in the decentralized governance of the platform. To analyze the findings, the theory of polycentric commons (Mindel et al., 2018; Ostrom, 1990) was used as a lens to develop explanatory polycentric governance mechanisms (Bunge, 2004). This essay contributes to platform governance literature by developing a dynamic model of collective platform ownership. The model consists of three mechanisms (“structuring ownership,” “harnessing collective,” and “governing protocols”) that explain how and why decentralized governance as implemented in DAOs facilitates collective action. Through “structuring ownership” DAOs baseline investing and shaping of the platform, enabling decentralized member actions. “Harnessing collective” is the process by which DAOs maximize participation while maintaining distinctness of actors and reinforcing formal procedures. By “governing protocols” DAOs make key decisions regarding the evolution of the protocols while ensuring automated processes reflect interests of the collective. Through the interplay of the three collective platform ownership mechanisms, a polycentric structure emerges where people coordinate and govern in a DAO, addressing tensions and problems related to collective action.

Overall Discussion

This thesis explored in five essays what tensions exist in centralized and decentralized digital platform contexts and how platform participants can respond to selected tensions. Beyond the individual contributions of each essay as elaborated in the previous section, this thesis makes three overarching contributions and has several implications for practitioners.

First, regarding the digital platform context, this thesis responds to calls for extending the boundaries of research on tensions associated with digital technologies (Yoo et al., 2012) by exploring novel empirical settings (see Figure 1). When tensions arise in a centralized platform context (see Figure 1) the findings of this thesis show that not only single platform owners (see essay 1) or multiple platform owners (see essay 3) have the power and agency to respond to tensions by aligning the platform architecture with the coordination of the collective organization to effectively influence value-enhancing interactions on the platform (e.g., Cennamo & Santaló, 2019; Tilson et al., 2010; Tiwana et al., 2010; Wareham et al., 2014) but also individual platform participants on the periphery of the platform (see essay 2) such as platform complementors or users (e.g., Brunswicker & Schecter, 2019; Eaton et al., 2015). When tensions arise in a decentralized platform context such as in decentralized autonomous organizations (see Figure 1), the findings from essays 4 and 5 show that the distributed participants of a DAO can respond to tensions based on decentralized governance that facilitates collective action (Beck et al., 2018; Chen et al., 2021; Lumineau et al., 2021; Rozas et al., 2021). The collective action perspective that is advanced in this thesis extends the line of research on platforms by offering a new lens for analyzing platforms as collective organizations in which tensions arise at the collective meta-organizational level (Cennamo & Santaló, 2019; Faraj et al., 2011). Such collective level tensions typically require collective responses by platform participants which may raise agency and power dynamics (Berti & Simpson, 2021) that future research could investigate in the context of centralized and decentralized digital platforms.

The second contribution of this thesis is the identification of novel tensions that become salient through the widespread deployment of digital technologies in new forms of platform organizing (Cennamo & Santaló, 2019; Gregory et al., 2015; Huber et al., 2017; Tilson et al., 2010; Tilson et al., 2021; Wareham et al., 2014). The synthesized findings across all five essays suggest that platform meta-organizations must respond to the tension of simultaneously effecting generativity of the technology and collectivity of the community through complex combinations of community-driven human and algorithmic mechanisms to ensure the alignment of autonomous actors with a shared purpose. In the context of centralized platforms (see Figure 1), essay 1 and prior research (e.g., Brunswicker & Schecter, 2019; Cennamo & Santaló, 2019; Eaton et al., 2015; Tilson et al., 2010) highlight key tensions related to generativity, i.e., unpredictable change resulting from innovation in platforms (Zittrain, 2008). Essays 2 and 3 identify mechanisms that appropriately

bound participant behavior without excessively constraining the desired level of generativity of the platform when developing and governing platforms. In the context of decentralized autonomous organizations (see Figure 1), essays 4 and 5 highlight collectivity associated with desirable change resulting from collective action and point to novel tensions such as token holders making sustained contributions to the DAO while earning financial rewards or the tension between governance via IT and governance of IT. The findings of this thesis suggest imbalances between generativity and collectivity, where one pole begins to dominate and has relative influence (Schad et al., 2016), depending on the context of centralized or decentralized digital platforms (see Figure 1). This tension between generativity and collectivity calls for future theory development and empirical evidence on appropriate mechanisms for actively responding to the tension to achieve a dynamic equilibrium (Smith & Lewis, 2011) between generativity and collectivity over time.

As a third contribution, this thesis offers both conceptual foundations and empirical evidence for a novel category of tensions (Lewis, 2000; Smith & Lewis, 2011)—socio-technical tensions—on which recent research has started to shed light on (Tilson et al., 2010; Tilson et al., 2021). In particular, essay 1 provides conceptual foundations for such a new category of socio-technical tensions by suggesting that certain tensions in digital platforms cycle through the technological architecture and organizational dimensions of their business model. While some of the tensions identified throughout this thesis echo tensions related to organizing, performing, learning, or belonging uncovered in prior organizational and management literature (e.g., Andriopoulos & Lewis, 2009; Jay, 2013; Lewis, 2000; Luscher & Lewis, 2008; Smith & Lewis, 2011; Smith, 2014; Smith & Tushman, 2005), they also differ in that they are inherently socio-technical or require socio-technical response mechanisms. For instance, essay 2 examines the tension between autonomy and alignment of human or organizational actors in a digital platform meta-organization and reveals eight digital technology-enabled mechanisms. In addition, while essay 3 provides empirical evidence for a tension that is primarily related to the development of the platform core technology, the tension between technological and market demands, the responses to this tension are related to the social dynamics between the platform owner firms that collaboratively develop the platform. Essays 4 and 5 provide empirical evidence and response mechanisms for a new socio-technical tension between governance via IT and governance of IT in DAOs that involves both contradictory yet interrelated social and technical elements. On the one hand, governance of IT in DAOs involves the community of distributed actors in the network who ultimately need to support, change, and adapt the design of the DAO to identify with the overall purpose. On the other hand, DAOs must rely on governance via IT through embedded algorithms that align individual actors toward the overall purpose of a DAO. These findings highlight that contradictory yet interrelated elements in the domain of digital platforms are not only embedded in organizing (Lewis, 2000; Smith & Lewis, 2011) but also embedded into the technological architecture of the DAO. The technological developments associated with digital platforms and DAOs increase the potential for

cross-fertilization between research on social and technical aspects of information systems (Sarker et al., 2019) and social and organizational aspects of tensions (Lewis, 2000; Smith & Lewis, 2011). Such a socio-technical perspective on tensions may help to generalize insights on tensions extracted from digital platforms to the broader class of digital technologies (Yoo et al., 2012) and broaden the conceptualization of the social and the technical being not only interrelated (Sarker et al., 2019) but often also contradictory yet interrelated (Lewis, 2000; Smith & Lewis, 2011).

The five essays in this thesis also have important implications for platform participants who can benefit from an increased awareness of socio-technical tensions in digital platforms. On the one hand, this thesis highlights tensions related to generativity and other tensions (see essay 1) such as the tensions between autonomy and alignment in platform governance (see essay 2) and between technological and market demands in platform development (see essay 3) that are typically salient in the context of centralized platforms. On the other hand, this thesis surfaces novel tensions related to collectivity (see essays 4 and 5) such as the tension between governance via IT and governance of IT that typically surface in the context of decentralized autonomous organizations. This increased awareness of socio-technical tensions helps platform participants to develop a collective paradoxical mindset (Miron-Spektor et al., 2018) by actively exploring tensions to tap the potential energy, insights, and power of tensions rather than avoiding or ignoring tensions. After becoming aware of tensions, a critical next step for platform participants is to accept and work through tensions by exploring appropriate response mechanisms. This thesis provides collective and technology-enabled response mechanisms to the identified socio-technical tensions that can be activated or deactivated by platform participants depending on the platform context. On the one hand, centralized platforms typically accent individual choices in activating or deactivating response mechanisms, for example, by single platform owners (see essay 1), multiple platform owners (see essay 3), or individual platform participants on the periphery of the platform (see essay 2) such as platform complementors or users. On the other hand, decentralized autonomous organizations enable the collective to activate or deactivate mechanisms to respond to tensions (see essays 4 and 5).

In addition to the limitations of each individual essay and the resulting implications for future research, the overall thesis also has limitations and boundary conditions that may provide avenues for future research. First, this thesis did not focus on the dynamic push and pulls between the poles of the identified tensions over time. Future research may unveil the longitudinal, dynamic interplay and balancing act of the identified tensions in this thesis, especially for the novel tensions related to collectivity that surface in the context of decentralized autonomous organizations (see essays 4 and 5). Second, the generalizability of the findings may be bounded by the unit of analysis of meta-organizations taken across all five essays. The emergent findings from the essays point to other units of analysis that may be worthwhile to explore in future research, for example, the perspective

of individual participants of a DAO creating a decentralized work environment that is not yet well understood in the literature including not only the opportunities but also the tensions and unique challenges it creates, and how participants respond to them.

In conclusion, digital platforms are rife with tensions but prior research on platforms often focused on individual tension elements but neglected possible related and conflicting elements or considered tensions but assumed that centralized platform owners can respond to tensions neglecting possible collective and technology-enabled response mechanisms. This thesis builds on the findings derived from five essays to (1) contribute a lens for analyzing platforms as collective organizations in which tensions arise at the collective meta-organizational level requiring collective responses, (2) identifies new tensions and response mechanisms related to generativity and collectivity, and (3) points to a novel category of socio-technical tensions that are especially salient in the context of digital platforms.

References

- Al-Debei, M. M., & Avison, D. (2010). Developing a unified framework of the business model concept. *European Journal of Information Systems*, 19(3), 359-376.
- Andersen, J. V., & Bogusz, C. I. (2019). Self-organizing in blockchain infrastructures: Generativity through shifting objectives and forking. *Journal of the Association for Information Systems*, 20(9), 1242-1273.
- Andriopoulos, C., & Lewis, M. W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, 20(4), 696-717.
- Armstrong, M. (2006). Competition in two-sided markets. *The RAND Journal of Economics*, 37(3), 668-691.
- Baldwin, C. Y., & Woodard, C. J. (2009). The Architecture of Platforms: A Unified View. In A. Gawer (Ed.), *Platforms, Markets and Innovation* (pp. 19-44). Edward Elgar Publishing.
- Beck, R., Mueller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. *Journal of the Association for Information Systems*, 19(10), 1020-1034.
- Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press.
- Berente, N., Lyytinen, K., Yoo, Y., & Maurer, C. (2019). Institutional logics and pluralistic responses to enterprise system implementation: A qualitative meta-analysis. *MIS Quarterly*, 43(3), 873-902.
- Berti, M., & Simpson, A. (2021). The Dark Side of Organizational Paradoxes: The Dynamics of Disempowerment. *Academy of Management Review*, 46(2), 252-274.
- Birks, D. F., Fernandez, W., Levina, N., & Nasirin, S. (2013). Grounded theory method in information systems research: Its nature, diversity and opportunities. *European Journal of Information Systems*, 22(1), 1-8.
- Boudreau, K. J. (2010). Open platform strategies and innovation: Granting access vs. devolving control. *Management Science*, 56(10), 1849-1872.
- Bresnahan, T., & Greenstein, S. (1999). Technological Competition and the Structure of the Computer Industry. *Journal of Industrial Economics*, 47(1), 1-40.
- Brunswick, S., & Schecter, A. (2019). Coherence or flexibility? The paradox of change for developers' digital innovation trajectory on open platforms. *Research Policy*, 48(8).
- Bunge, M. (2004). How Does It Work?: The Search for Explanatory Mechanisms. *Philosophy of the Social Sciences*, 34(2), 182-210.

- Buterin, V. (2014a). *DAOs, DACs, DAs and More: An Incomplete Terminology Guide*. Retrieved February 12, 2021 from <https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide/>
- Buterin, V. (2014b). *Ethereum: A next-generation smart contract and decentralized application platform*. Retrieved March 30, 2021 from <https://ethereum.org/en/whitepaper/>
- Cennamo, C., Marchesi, C., & Meyer, T. (2020). Two sides of the same coin? Decentralized versus proprietary blockchains and the performance of digital currencies. *Academy of Management Discoveries*, 6(3), 382–405.
- Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science*, 30(3), 617–641.
- Charmaz, C. (2006). *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*. SAGE Publications.
- Chen, Y., Pereira, I., & Patel, P. C. (2021). Decentralized Governance of Digital Platforms. *Journal of Management*, 47(5), 1305–1337.
- Ciborra, C. U. (1996). The Platform Organization: Recombining Strategies, Structures, and Surprises. *Organization Science*, 7(2), 103–118.
- Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Platforms and Infrastructures in the Digital Age. *Information Systems Research*, 29(2), 381–400.
- Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in Poor Visibility: How Firms Play the Ecosystem Game when Uncertainty is High. *Academy of Management Journal*, 61(2), 466–498.
- De Filippi, P., & Wright, A. (2018). *Blockchain and the Law: The Rule of Code*. Harvard University Press.
- de Reuver, M., Sørensen, C., & Basole, R. C. (2018). The Digital Platform: A Research Agenda. *Journal of Information Technology*, 33(2), 124–135.
- Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed Tuning of Boundary Resources: The Case of Apple's iOS Service System. *MIS Quarterly*, 39(1), 217–243.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, 14(4), 532–550.
- Eisenmann, T. R., Parker, G., & Van Alstyne, M. W. (2006). Strategies for Two-Sided Markets. *Harvard Business Review*, 84(10), 92–101.
- Ellinger, E. W., Mini, T., Gregory, R. W., Widjaja, T., & Henfridsson, O. (2022). *Skin in the Game in DAO Governance: A Dynamic Model of Collective Platform Ownership*.
- Evans, D. S. (2003). Some Empirical Aspects of Multi-sided Platform Industries. *Review of Network Economics*, 2(3), 191–209.
- Evans, D. S., & Schmalensee, R. (2007). The Industrial Organization of Markets with Two-Sided Platforms. *Competition Policy International*, 3(1), 150–179.
- Faraj, S., Jarvenpaa, S. L., & Majchrzak, A. (2011). Knowledge Collaboration in Online Communities. *Organization Science*, 22(5), 1224–1239.
- Farjoun, M. (2010). Beyond dualism: Stability and change as a duality. *Academy of Management Review*, 35(2), 202–225.
- Fichman, R. G. (2004). Real Options and IT Platform Adoption: Implications for Theory and Practice. *Information Systems Research*, 15(2), 132–154.
- Furr, N., & Shipilov, A. (2018). Building the right ecosystem for innovation. *MIT Sloan Management Review*, 59(4), 59–64.
- Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, 43(7), 1239–1249.
- Gawer, A., & Cusumano, M. A. (2008). How companies become platform leaders. *MIT Sloan Management Review*, 49(2), 68–75.
- Gerring, J. (2006). *Case Study Research: Principles and Practices*. Cambridge University Press.
- Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. *Information Systems Journal*, 23(2), 173–192.
- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, 16(1), 15–31.

- Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research* (1 ed.). Aldine Publishing Company.
- Gregory, R. W., Kaganer, E., Henfridsson, O., & Ruch, T. J. (2018). IT Consumerization and the Transformation of IT Governance. *MIS Quarterly*, 42(4), 1225-1253.
- Gregory, R. W., Keil, M., Muntermann, J., & Mähring, M. (2015). Paradoxes and the Nature of Ambidexterity in IT Transformation Programs. *Information Systems Research*, 26(1), 57-80.
- Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal*, 33(6), 571-586.
- Hassan, S., & De Filippi, P. (2021). Decentralized Autonomous Organization. *Internet Policy Review*, 10(2).
- Hsieh, Y. Y., Vergne, J. P., Anderson, P., Lakhani, K., & Reitzig, M. (2018). Bitcoin and the rise of decentralized autonomous organizations. *Journal of Organization Design*, 7(1), 1-16.
- Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance Practices in Platform Ecosystems: Navigating Tensions Between Cocreated Value and Governance Costs. *Information Systems Research*, 28(3), 563-584.
- Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, 39(8), 2255-2276.
- Jay, J. (2013). Navigating paradox as a mechanism of change and innovation in hybrid organizations. *Academy of Management Journal*, 56(1), 137-159.
- Kretschmer, T., Leiponen, A., Schilling, M., & Vasudeva, G. (2022). Platform ecosystems as meta-organizations: Implications for platform strategies. *Strategic Management Journal*, 43(3), 405-424.
- Lewis, M. W. (2000). Exploring paradox: Toward a more comprehensive guide. *Academy of Management Review*, 25(4), 760-776.
- Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain Governance—A New Way of Organizing Collaborations? *Organization Science*, 32(2), 500-521.
- Luscher, L. S., & Lewis, M. W. (2008). Organizational change and managerial sensemaking: Working through paradox. *Academy of Management Journal*, 51(2), 221-240.
- MakerDAO. (2017). *The Maker Protocol: MakerDAO's Multi-Collateral Dai (MCD) System*. Retrieved March 18, 2021 from <https://makerdao.com/en/whitepaper/>
- McIntyre, D., Srinivasan, A., Afuah, A., Gawer, A., & Kretschmer, T. (2021). Multisided Platforms as New Organizational Forms. *Academy of Management Perspectives*, 35(4), 566-583.
- Mindel, V., Mathiassen, L., & Rai, A. (2018). The Sustainability of Polycentric Information Commons. *MIS Quarterly*, 42(2), 607-631.
- Mini, T. (2022). *The Diverging and Converging of Multiple Partners in Digital Platform Development*.
- Mini, T., Ellinger, E. W., Gregory, R. W., & Widjaja, T. (2021). An Exploration of Governing via IT in Decentralized Autonomous Organizations. Proceedings of the 42nd International Conference on Information Systems, Austin, TX, USA.
- Mini, T., & Widjaja, T. (2019). Tensions in Digital Platform Business Models: A Literature Review. Proceedings of the 40th International Conference on Information Systems, Munich, Germany.
- Mini, T., Widjaja, T., & Gregory, R. W. (2020). *Autonomy and Alignment in Platform-based Meta-organizations: A Qualitative Meta-analysis*.
- Miron-Spektor, E., Ingram, A., Keller, J., Smith, W. K., & Lewis, M. W. (2018). Microfoundations of Organizational Paradox: The Problem Is How We Think about the Problem. *Academy of Management Journal*, 61(1), 26-45.
- Moehlmann, M., Zalmanson, L., Henfridsson, O., & Gregory, R. W. (2021). Algorithmic Management of Work on Online Labor Platforms: When Matching Meets Control. *MIS Quarterly*, 45(4), 1999-2022.
- Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2021). Contracting in the Smart Era: The Implications of Blockchain and Decentralized Autonomous Organizations for Contracting and Corporate Governance. *Academy of Management Perspectives*, 35(4), 622-641.

- Murthy, R. K., & Madhok, A. (2021). Overcoming the Early-stage Conundrum of Digital Platform Ecosystem Emergence: A Problem-Solving Perspective. *Journal of Management Studies*, 58(7), 1899-1932.
- Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. Retrieved April 1, 2021 from <https://bitcoin.org/bitcoin.pdf>
- Noblit, G. W., & Hare, R. D. (1988). *Meta-ethnography: Synthesizing qualitative studies* (11 ed.). SAGE Publications.
- O'Mahony, S., & Ferraro, F. (2007). The Emergence of Governance in an Open Source Community. *Academy of Management Journal*, 50(5), 1079-1106.
- O'Mahony, S., & Karp, R. (2022). From proprietary to collective governance: How do platform participation strategies evolve? *Strategic Management Journal*, 43(3), 530-562.
- Oliveira, L., Zavolokina, L., Bauer, I., & Schwabe, G. (2018). To Token or not to Token: Tools for Understanding Blockchain Tokens. Proceedings of the 39th International Conference on Information Systems, San Francisco, CA, USA.
- Olson, M. (1965). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press.
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Ostrom, E. (2000). Collective Action and the Evolution of Social Norms. *The Journal of Economic Perspectives*, 14(3), 137-158.
- Puranam, P., Alexy, O., & Reitzig, M. (2014). What's "new" about new forms of organizing? *Academy of Management Review*, 39(2), 162-180.
- Putnam, L. L., Fairhurst, G. T., & Banghart, S. (2016). Contradictions, Dialectics, and Paradoxes in Organizations: A Constitutive Approach. *Academy of Management Annals*, 10(1), 65-171.
- Qiu, Y., Gopal, A., & Hann, I.-H. (2017). Logic Pluralism in Mobile Platform Ecosystems: A Study of Indie App Developers on the iOS App Store. *Information Systems Research*, 28(2), 225-249.
- Rochet, J.-C., & Tirole, J. (2003). Platform Competition in Two-Sided Markets. *Journal of the European Economic Association*, 1(4), 990-1029.
- Rochet, J.-C., & Tirole, J. (2006). Two-Sided Markets: A Progress Report. *The RAND Journal of Economics*, 37(3), 645-667.
- Rolland, K. H., Mathiassen, L., & Rai, A. (2018). Managing Digital Platforms in User Organizations: The Interactions Between Digital Options and Digital Debt. *Information Systems Research*, 29(2), 419-443.
- Rozas, D., Tenorio-Fornés, A., Díaz-Molina, S., & Hassan, S. (2021). When Ostrom Meets Blockchain: Exploring the Potentials of Blockchain for Commons Governance. *SAGE Open*, 11(1).
- Sarker, S., Chatterjee, S., Xiao, X., & Elbanna, A. (2019). The sociotechnical axis of cohesion for the IS discipline: its historical legacy and its continued relevance. *MIS Quarterly*, 43(3), 695-720.
- Schad, J., Lewis, M. W., Raisch, S., & Smith, W. K. (2016). Paradox Research in Management Science: Looking Back to Move Forward. *Academy of Management Annals*, 10(1), 5-64.
- Schirmacher, N.-B., Jensen, J. R., & Avital, M. (2021). Token-Centric Work Practices in Fluid Organizations: The Cases of Yearn and MakerDAO. Proceedings of the 42nd International Conference on Information Systems, Austin, TX, USA.
- Shi, X., Li, F., & Chumnumpan, P. (2021). Platform Development: Emerging Insights From a Nascent Industry. *Journal of Management*, 47(8), 2037-2073.
- Shipilov, A., & Gawer, A. (2020). Integrating Research on Interorganizational Networks and Ecosystems. *Academy of Management Annals*, 14(1), 92-121.
- Smith, W., & Lewis, M. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review*, 36(2), 381-403.
- Smith, W. K. (2014). Dynamic decision making: A model of senior leaders managing strategic paradoxes. *Academy of Management Journal*, 57(6), 1592-1623.
- Smith, W. K., & Tushman, M. L. (2005). Managing strategic contradictions: A top management model for managing innovation streams. *Organization Science*, 16(5), 522-536.

- Szabo, N. (1996). Smart contracts: building blocks for digital markets. *EXTROPY: The Journal of Transhumanist Thought*, 18(2).
- Szabo, N. (1997). Formalizing and Securing Relationships on Public Networks. *First Monday*, 2(9).
- Taleb, N. N. (2018). *Skin in the game: Hidden asymmetries in daily life*. Random House Trade Paperbacks.
- Tan, B., Pan, S. L., Lu, X., & Huang, L. (2015). The role of its capabilities in the development of multi-sided platforms: The digital ecosystem strategy of alibaba.com. *Journal of the Association of Information Systems*, 16(4), 248-280.
- Taudes, A., Feurstein, M., & Mild, A. (2000). Options Analysis of Software Platform Decisions: A Case Study. *MIS Quarterly*, 24(2), 227-243.
- Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, 43(2-3), 172-194.
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Digital Infrastructures: The Missing IS Research Agenda. *Information Systems Research*, 21(4), 748-759.
- Tilson, D., Sørensen, C., & Lyytinen, K. (2021). Digitally Induced Industry Paradoxes: Disruptive Innovations of Taxiwork and Music Streaming Beyond Organizational Boundaries. In R. Bednarek, M. P. e Cunha, J. Schad, & W. K. Smith (Eds.), *Interdisciplinary Dialogues on Organizational Paradox: Learning from Belief and Science, Part A (Research in the Sociology of Organizations, Vol. 73a)* (Vol. 73a, pp. 171-192). Emerald Publishing Limited.
- Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research*, 21(4), 675-687.
- Urquhart, C. (2013). *Grounded Theory for Qualitative Research*. SAGE Publications.
- Vergne, J. (2020). Decentralized vs. Distributed Organization: Blockchain, Machine Learning and the Future of the Digital Platform. *Organization Theory*, 1(4), 1-26.
- vom Brocke, J., Simons, A., Riemer, K., Niehaves, B., Plattfaut, R., & Cleven, A. (2015). Standing on the shoulders of giants: Challenges and recommendations of literature search in information systems research. *Communications of the Association for Information Systems*, 37(1), 205-224.
- von Hippel, E., & von Krogh, G. (2003). Open Source Software and the “Private-Collective” Innovation Model: Issues for Organization Science. *Organization Science*, 14(2), 209-223.
- Voshmgir, S. (2020). *Token Economy: How the Web3 Reinvents the Internet*. Token Kitchen.
- Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology Ecosystem Governance. *Organization Science*, 25(4), 1195-1215.
- Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, 26(2), xiii-xxiii.
- Werbach, K., & Cornell, N. (2017). Contracts Ex Machina. *Duke Law Journal*, 67, 313-382.
- West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research Policy*, 32(7), 1259-1285.
- Yin, R. K. (2009). *Case Study Research and Applications: Design and Methods* (Vol. 4). SAGE Publications.
- Yoo, Y., Boland, J. R. J., Lyytinen, K., & Majchrzak, A. (2012). Organizing for Innovation in the Digitized World. *Organization Science*, 23(5), 1398-1408.
- Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. *Information Systems Research*, 21(4), 724-735.
- Zittrain, J. L. (2008). *The Future of the Internet*. Yale University Press.

Essay 1: Tensions in Digital Platform Business Models: A Literature Review

- Authors:** Tobias Mini, University of Passau, Germany
Thomas Widjaja, University of Passau, Germany
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Abstract

Digital platform business models consist of conflicting elements that often create tensions. We integrate the tension and business model perspectives to explore what set of interrelated tensions platform owners face when continuously designing, adapting, and/or redesigning their digital platform business model. For this purpose, we systematically reviewed information systems literature resulting in 21 unique tensions that platform owners face when crafting business models. We provide a theory for analyzing tensions in digital platform business models by classifying tensions into categories of tensions (i.e., organizing, performing, learning, and belonging) and business model dimensions (i.e., value architecture, value network, value finance, and value proposition). We highlight for business model research which business model dimensions are rich with tensions. Additionally, we integrate tensions that were largely considered in isolation by past digital platform research. This integration helps to avoid conceptual ambiguity and reveals chains and cycles between tensions.

⁴ This list does *not* include presentations held by co-authors.

Tensions in Digital Platform Business Models: A Literature Review

Completed Research Paper

Tobias Mini

University of Passau

Chair of Business Information Systems
Dr.-Hans-Kapfinger-Strasse 12,
94032 Passau, Germany
tobias.mini@uni-passau.de

Thomas Widjaja

University of Passau

Chair of Business Information Systems
Dr.-Hans-Kapfinger-Strasse 12,
94032 Passau, Germany
thomas.widjaja@uni-passau.de

Abstract

Digital platform business models consist of conflicting elements that often create tensions. We integrate the tension and business model perspectives to explore what set of interrelated tensions platform owners face when continuously designing, adapting, and/or redesigning their digital platform business model. For this purpose, we systematically reviewed information systems literature resulting in 21 unique tensions that platform owners face when crafting business models. We provide a theory for analyzing tensions in digital platform business models by classifying tensions into categories of tensions (i.e., organizing, performing, learning, and belonging) and business model dimensions (i.e., value architecture, value network, value finance, and value proposition). We highlight for business model research which business model dimensions are rich with tensions. Additionally, we integrate tensions that were largely considered in isolation by past digital platform research. This integration helps to avoid conceptual ambiguity and reveals chains and cycles between tensions.

Keywords: Digital Platform, Tension, Dilemma, Paradox, Business Model, Literature Review

Introduction

Managing a digital platform business model to create, deliver, and capture value is a challenging task for platform owners as a business model consists of conflicting elements that often create tensions (Al-Debei and Avison 2010; Smith et al. 2010; Teece 2010). While past discussions about business models (e.g., Al-Debei and Avison 2010; Teece 2010; Zott et al. 2011) and tensions (e.g., Lewis 2000; Smith and Lewis 2011) in general were largely held in isolation from each other, both research streams assume conflicting elements that have to be managed (Al-Debei and Avison 2010; Smith et al. 2010; Zott and Amit 2007). We integrate these two areas of research for the exploration of tensions in digital platform business models.

Existing literature on business models (e.g., Al-Debei and Avison 2010; Teece 2010; Zott and Amit 2007) and tensions (e.g., Lewis 2000; Smith 2014; Smith and Lewis 2011; Smith and Tushman 2005) discussed opposing elements in various contexts. However, we want to adapt these discussions to the digital platform context. Digital platforms consist of an extensible platform core shared by digital complements (e.g., apps) that interoperate with it via interfaces (Tiwana et al. 2010). Past digital platform research enriched our understanding about specific elements of digital platform business models. Like, for example, the architecture and governance of digital platforms and ecosystems (e.g., Tiwana et al. 2010), power and trust (e.g., Hurni and Huber 2014), platform competition (e.g., Kazan et al. 2018), or platform merger and acquisitions (e.g., Dowie et al. 2017). However, these studies often considered their focal elements in isolation, neglecting possible related and conflicting elements. Nevertheless, some studies in the digital

platform context explicitly considered tensions (e.g., Ghazawneh and Henfridsson 2013; Tilson et al. 2010; Wareham et al. 2014) but without taking business model design into consideration.

The integration of business models and tensions might be useful as especially platform owners face tensions when they want to manage their digital platform business model (Boudreau and Lakhani 2009). For example, Google faced the tension between the elements of openness and control when managing the business model for its popular Android platform. While the business model of the Android platform initially relied on an open architecture to attract complementary app developers, Amazon and others took advantage of this openness and cloned almost the entire platform due to lack of control over the ecosystem (Karhu et al. 2018). However, by making sense of this openness vs. control tension, Google was able to successfully derive appropriate management strategies (Karhu et al. 2018). As this example illustrates, platform owners play a significant role in the management of tensions in digital platform business models and the role of the platform owner is especially challenging because digital platforms are evolving and generative (Tiwana et al. 2010). Thus, the focus of this study is on the platform owner while we acknowledge the oftentimes limited agency of platform owners as tensions and management strategies often affect other ecosystem actors.

In summary, we know that tensions are salient in digital platform business models and are relevant both for platform owners and researchers. However, we lack a coherent understanding about *what these tensions are and how they interrelate*. Therefore, our research question is stated as follows:

What set of interrelated tensions do platform owners face when continuously designing, adapting, and/or redesigning their digital platform business model?

By reviewing existing digital platform research we aim to describe the phenomenon of tensions in digital platform business models. We therefore classify the identified tensions into different categories of tensions (i.e., organizing, performing, learning, and belonging) proposed by Smith and Lewis (2011) and into the business model dimensions (i.e., value architecture, value network, value finance, and value proposition) proposed by Al-Debei and Avison (2010). With this description and classification we provide a theory for analyzing (cf. Gregor 2006) and contribute to the growing literature on business models and digital platforms by showing what set of interrelated tensions are salient on digital platforms and how they relate together. Specifically, we contribute to business model research by transferring the business model framework of Al-Debei and Avison (2010) to the digital platform context and highlighting which business model dimensions are rich with tensions. In addition, the integrated view on tensions helps digital platform research to avoid conceptual ambiguity and reveals interrelations between tensions (e.g., chains and cycles).

In the following section, we first provide conceptual foundations. Then, we present our used research method by outlining the literature review design and classification procedure. Next, we describe the tensions that were identified through the literature review following their affiliation to a certain category of tension. We conclude with the discussion of our findings, limitations, and avenues for future research.

Conceptual Foundations

In the following three subsections we define the concepts of (1) digital platforms and ecosystems, (2) business models, and (3) tensions, dilemmas, paradoxes, and management strategies.

Digital Platforms and Ecosystems

We understand digital platforms and ecosystems as modular and granular digital artifacts. Digital platforms and ecosystems as digital artifacts thus share the dimensions of editability, interactivity, openness and reprogrammability, and distributedness (Kallinikos et al. 2013).

Past research followed mainly three theoretical perspectives on the concept of digital platforms: economic, engineering, and organizational (Gawer 2014). First, the economic perspective considers two- or multi-sided markets that mediate interactions between two or multiple market sides and emphasizes the importance of (cross-side) network effects (i.e., increasing the number of users on one side of the platform makes it more valuable to the users on the other side (Eisenmann et al. 2006)). Second, from the engineering perspective, platforms are seen as general-purpose technologies that enable applications and related business opportunities (Fichman 2004). More specifically, digital platforms consist of an integrated, layered-modular architecture with a set of stable components and core functionality (i.e., the platform core)

shared by the modules/complements (e.g., apps or add-ons) that interoperate with it via rules or standardized interfaces like application programming interfaces (APIs) or software development kits (SDKs) (Baldwin and Woodard 2009; Boudreau 2010; Ghazawneh and Henfridsson 2013; Tiwana et al. 2010; Yoo et al. 2010). In this paper we adopt the third perspective – the organizational perspective on platforms – as this lens includes the economic and engineering perspectives and considers both technical and social aspects. The organizational perspective conceptualizes platforms as “meta-organizations” with stable organizational structures and temporary arrangements with frequently changing organizational structures or products (Ciborra 1996). Such platform organizations can be characterized by three aspects: (1) they coordinate actors (i.e., individuals or firms) who can both compete and innovate, (2) make use of economies of scope in both supply and/or demand, and (3) consist of a modular technological architecture with a core and peripheral components (Gawer 2014). The platform core with digital complements on the periphery that connect via interfaces then are part of a larger digital ecosystem.

Originating from biology, the ecosystem concept has been investigated from three different theoretical perspectives in past research: business ecosystems, innovation ecosystems, and platform ecosystems (Jacobides et al. 2018). First, business ecosystems form an economic community which consists of interacting organizations or individuals who deliver value to customers and are aligned by the rules set by one or more central companies (Moore 1996). These central companies are often referred to as “keystone organizations” or “hubs” (Iansiti and Levien 2004). Second, innovation ecosystems are centered around a focal innovation where collaborative arrangements among social and economic actors combine their individual offerings into a coherent and customer-oriented solution or value proposition (Adner 2006; Adner 2017). In this paper we focus on the platform ecosystem perspective that views platforms as “hubs” that enable digital complements (i.e., “spokes”) to connect via boundary resources (Jacobides et al. 2018). Especially emphasized in this perspective is the interdependence between the platform owner and complementors. Platform owners can be divided into platform providers who mediate users’ interactions and platform sponsors who control the technology and participation rights (Eisenmann 2008). For the purpose of this paper, we consolidate those two roles and take the perspective of the platform owner. Complementors (e.g., app developers) on the other hand can be referred to as autonomous actors who use their entrepreneurial instinct to address consumer needs by creating novel innovations (Wareham et al. 2014). These innovations often take the form of digital complements (e.g., apps or add-ons) that refer to executable pieces of software that make a focal product (i.e., the platform) more attractive (Brandenburger and Nalebuff 1996; Ghazawneh and Henfridsson 2013). Complementors are thus developers of digital complements. The relationship between platform owners and complementors is often governed at arm’s length via boundary resources that contain software tools and regulations and form the interface between platform and digital complement (Ghazawneh and Henfridsson 2013).

Business Models

Besides digital platforms, digitality can also be an inherent property of business models. In this study we particularly focus on digital business models that emerge when traditional business practices are fundamentally altered by changes in digital technologies (Veit et al. 2014). However, traditional business model research forms the underlying basis for digital business models.

While the business model itself is centered on a focal organization, the activities derived from it are boundary-spanning (Zott et al. 2011). These interrelated and boundary-spanning organizational activities, i.e., the contribution of human, physical, or financial resources to the business model, form an activity system which reveals the systemic nature of the business model concept (Zott and Amit 2010; Zott et al. 2011). Viewing business models as systems assembled of a dynamic set of components and linkages between those components (Afuah and Tucci 2003), different business model frameworks emerged. Past research on business model frameworks largely partitioned business model components (e.g., value creation, delivery, and capture (Teece 2010)) into distinct dimensions (e.g., value architecture, value network, value finance, and value proposition (Al-Debei and Avison 2010)) which, in turn, were subdivided into single elements or activities (e.g., content, structure, or governance (Zott and Amit 2010)) (Al-Debei and Avison 2010). As these elements are steadily evolving, the task for managers is to continuously design, adapt, and/or redesign the various elements so that they work together as a system while managing the often conflicting elements as improvements in one element may adversely affect another element (Al-Debei and Avison 2010; Demil and Lecocq 2010; Hedman and Kalling 2003).

Tensions, Dilemmas, Paradoxes, and Management Strategies

Similar to business models, conflicting elements are also central to research on tensions. Tensions arise when individuals cognitively and/or socially construct polarities that hide the simultaneity of conflicting elements (Lewis 2000; Smith and Lewis 2011). Choices made by individuals between the elements of a tension then lead to feelings of stress or anxiety (Putnam et al. 2016). In this study, we classify tensions as either dilemmas or paradoxes as individuals often experience both when dealing with tensions (Luscher and Lewis 2008; Smith 2014; Smith and Lewis 2011).

Dilemmas denote tensions in which each element is imposed with clear advantages and disadvantages (Smith and Lewis 2011). Weighing advantages and disadvantages of each element and then making a tradeoff or “either-or” decision could resolve dilemmas (Luscher and Lewis 2008; Smith 2014). Still, when such tradeoffs are just temporary but resurface and persist, dilemmas become paradoxical.

Paradoxes can be defined as “contradictory yet interrelated elements (dualities) that exist simultaneously and persist over time; such elements seem logical when considered in isolation, but irrational, inconsistent, and absurd when juxtaposed” (Smith and Lewis 2011, p. 387).

Recent research on tensions identified four interrelated tension categories: (1) organizing tensions surface when complex organizational systems create competing designs and processes; (2) performing tensions arise when a plurality of actors seek for conflicting goals; (3) learning tensions involve using and often destroying past practices to create new ones; and (4) belonging tensions stem from competing identities with which individuals identify with (Lewis 2000; Luscher and Lewis 2008; Smith and Lewis 2011).

To cope with tensions, recent studies identified three broad management strategies: either-or, both-and, and more-than (Putnam et al. 2016; Smith and Lewis 2011). Either-or responses seek to resolve paradoxes by, for example, choosing one element to the detriment of the other or spatially and/or temporally separating tensions (Poole and van de Ven 1989; Putnam et al. 2016). Separation is well known from structural ambidexterity research in which tensions are best managed by situating two elements of a tension at two different organizational levels (i.e., spatial separation) and/or choosing different elements for different time periods at the same organizational level (i.e., temporal separation) (Gibson and Birkinshaw 2004; Poole and van de Ven 1989; Smith and Lewis 2011). However, either-or strategies often lead to vicious cycles that temporarily reduce anxiety, yet eventually intensify tensions (Lewis 2000). Thus, while either-or strategies could potentially resolve dilemmas, interwoven and persistent paradoxes demand more intricate management strategies (Luscher and Lewis 2008).

Both-and strategies on the other hand explicitly consider the interdependence of contradictory elements (Putnam et al. 2016). The use of both-and strategies often includes oscillation between the elements of a tension (e.g., shifting between elements at different times) or integration and balance (Putnam et al. 2016). Balance and integration aim at accepting the tension and actively confronting the tension via iterative separation and integration responses to seek a balance or dynamic equilibrium (Smith and Lewis 2011). For example, contextual ambidexterity (cf. Gibson and Birkinshaw 2004) often stresses social and behavioral means to integrate the elements of a tension (Andriopoulos and Lewis 2009). Coping with tensions through both-and strategies offers the potential to fuel virtuous cycles but also the danger to restore either-or choices or neglecting the creative potential of tensions (Putnam et al. 2016).

Alternatively, more-than responses consider, for example, reframing and transcendence of tensions such that the elements of a tension become encompassed inside each other to form a new perspective or the introduction of a third element that goes beyond the existing elements (Putnam et al. 2016). For example, Gregory et al. (2015) propose finding blended solutions that show how two tension elements are only seemingly paradoxical but synergistically combinable could be such an more-than strategy. Although, while more-than approaches unleash the creative synergy from tensions, such strategies are often very complex and may trigger unintended consequences (Putnam et al. 2016).

Methodology

The overarching goal of the literature review in this study is to describe and classify what set of interrelated tensions have been identified by past digital platform research. The following paragraphs describe the design of the literature review and classification procedure used in this study.

Design of the Structured Literature Review

The literature review was guided by the recommendations of Webster and Watson (2002) and vom Brocke et al. (2015). Hence, we first laid out the criteria for studies to be included in our review, then defined a search strategy, and finally outlined a scheme for analyzing and classifying the identified studies similar to Leidner and Kayworth (2006). We predefined three inclusion criteria: (1) the unit of analysis of a study must be on digital platforms or ecosystems; (2) studies must examine at least one tension in detail (based on our personal judgment whether the examined tensions met the definition of tensions, dilemmas, or paradoxes described in the previous section); (3) only peer reviewed papers were considered.

To find literature that contributes to the goal of this study, we used the four steps recommended by vom Brocke et al. (2009). First, the leading information systems journals in the Senior Scholars' Basket of Journals of the Association for Information Systems were chosen as the literature sources for this paper. Second, the databases Business Source Premier and Scopus were used for the database search. Third, we constructed a string of keywords for a keyword search. This string contained synonyms for platform and ecosystem for the title and synonyms for digitality, platform, and ecosystem for the abstract¹. This separation explicitly accounted for digitality in the abstract and thus narrowed our search focus on digital platforms and ecosystems. We derived these keywords from existing digital platform literature reviews (de Reuver et al. 2018; Nischak et al. 2018; Schrieck et al. 2016). Finally, we performed a backward search via Scopus on the basis of the previously identified articles but explicitly broadened our search to other outlets outside the information systems discipline (Webster and Watson 2002).

We obtained 147 studies on Business Source Premier and 184 studies on Scopus. After removing duplicates, we carefully screened their titles and abstracts (resulting in 100 articles) and reviewed the full texts (resulting in 71 articles) using inclusion criteria (1). Based on these 71 articles we performed a backward search (resulting in additional 52 articles). Subsequently, we reviewed the full texts of the 123 articles for synonyms of tensions that were mentioned in previous literature on tensions (i.e., using inclusion criteria (2)). Our final literature set consisted of 26 articles that consider tensions in their study. From these studies, 18 studies were published in the Senior Scholars' Basket of Journals and 8 studies in other outlets. The 26 studies along with additional information regarding the tension, the definition of each element of a tension, and management strategies that are mentioned are displayed in Tables 1 - 5.

Classification Procedure

Each article was further analyzed in four steps. First, we examined the identified articles for management strategies. According to our conceptualization of management strategies (see the previous section) we classified the obtained management strategies as (1) either-or, if only one tension element is managed; (2) both-and, if the tension is balanced or tension elements are integrated; or (3) more-than, if tension elements are blended or tensions are creatively managed by introducing a third element.

Second, we classified the identified tensions as paradox when the respective tensions were described as persistent or resurface after choice or otherwise as dilemmas. We also consulted the general (i.e., not focused on digital platforms) literature on tensions (e.g., Lewis 2000; Luscher and Lewis 2008; Smith and Lewis 2011), whether the respective tension has so far been classified as paradox or dilemma in this more general stream of research.

Third, we classified the identified tensions into the four categories of "organizing", "performing", "learning", and "belonging" proposed by Smith and Lewis (2011) (see Figure 1). To identify the tension category, we used the definition of each single tension element and compared it with the definition of each category (see Figure 1) and classifications of this element in past tension research (e.g., Lewis 2000; Luscher and Lewis 2008; Smith and Lewis 2011). With this approach we were able to form a personal judgement and derive the tension category or possibly a combination of categories for one tension.

¹ The specific keywords were: platform*, "multi-sid**", multisid*, "two-sid**", twosid*, ecosystem*, "eco-system**", or "eco system**" for the *title* and digit*, software*, electronic*, or virtual* and platform*, "multi-sid**", multisid*, "two-sid**", twosid*, ecosystem*, "eco-system**", or "eco system**" for the *abstract*.

<p>Category 1: Organizing</p> <p>Structuring and leading foster collaboration and competition, empowerment and direction, and control and flexibility</p>	<p>Category 2: Performing</p> <p>Plurality fosters multiple and competing goals as stakeholders seek divergent organizational success</p>
<p>Category 3: Learning</p> <p>Efforts to adjust, renew, change, and innovate foster tensions between building upon and destroying the past to create the future</p>	<p>Category 4: Belonging</p> <p>Identity fosters tensions between the individual and the collective and between competing values, roles, and memberships</p>

Figure 1. Categories of Tensions based on Smith and Lewis (2011, p. 383)

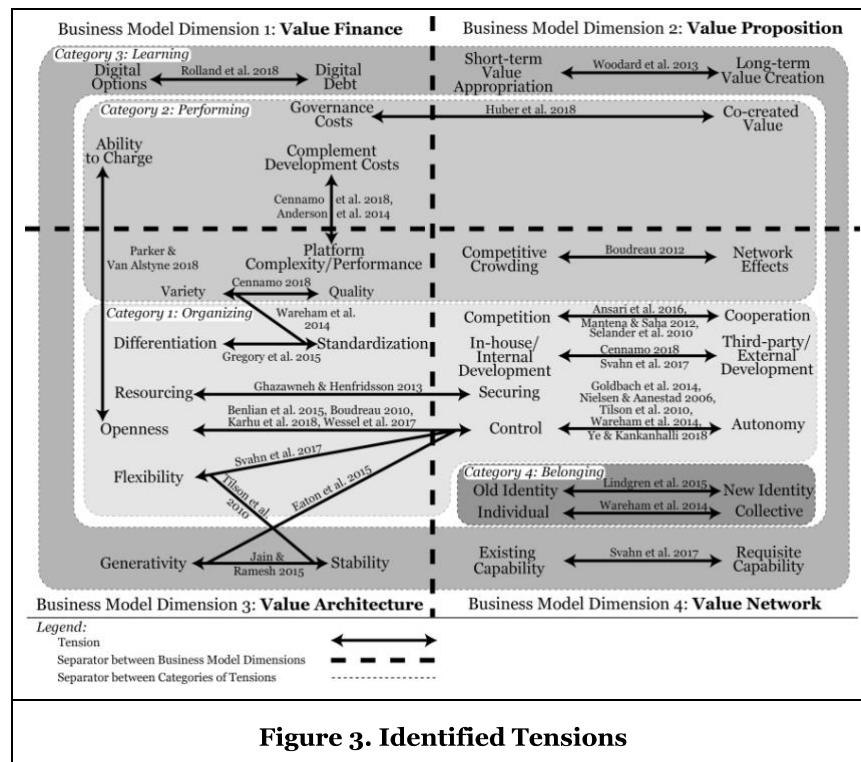
Finally, we complemented the classification into different categories of tensions (Smith and Lewis 2011) with the use of the business model framework proposed by Al-Debei and Avison (2010) to classify tensions identified by our literature review. This business model framework contains the four dimensions of “value architecture”, “value network”, “value finance”, and “value proposition” (see Figure 2). Al-Debei and Avison (2010) outline the four business model dimensions as follows. First, the value architecture is concerned with the organizations’ technological architecture which comprises core resources, the configuration of these resources, and core competencies. Second, the value network utilizes an inter-organizational perspective which contains actors (e.g., customers, suppliers, or competitors) along with their relationships. Thus, the value network can be open – in the sense that any actor can contribute – or more closed. Additionally, actors can take on certain roles to contribute in value creation, capture, and delivery. Also, the value network contains the governance mechanisms that are relevant to manage the network of actors. Third, the value finance dimension includes costing (e.g., transaction costs), pricing methods, and the revenue structure. Finally, the value proposition dimension deals with the products, services, and value elements that are offered. To classify the identified tensions into business model dimensions, we assessed which definition of the four business model dimensions is closest to the definition of the two elements of each tension. The choice of this framework was based on the following two reasons. First, this framework is parsimonious as it includes all business model dimensions that were mentioned in past conceptualizations of business models (Al-Debei and Avison 2010). Second, this framework captures the multidimensionality of the business model concept which is required to analyze tensions (Lewis 2000).

<p>Business Model Dimension 1: Value Finance</p>	<p>Business Model Dimension 2: Value Proposition</p>
<p>Business Model Dimension 3: Value Architecture</p>	<p>Business Model Dimension 4: Value Network</p>

Figure 2. Business Model Framework based on Al-Debei and Avison (2010, p. 368)

Results: Identified Tensions

In this section, we present the findings of our literature review and describe as well as classify the identified tensions in digital platform business models. Similar to Smith et al. (2013), the presentation of our results follows our classification procedure into different categories of tensions identified by Smith and Lewis (2011) (i.e., organizing, performing, learning, and belonging). We first present those tensions that matched a single category and then those tensions whose elements belong to two different categories (i.e., tensions across categories). In the following five subsections, we briefly describe each category, the number of identified tensions along with the span within or across the four business model dimensions proposed by Al-Debei and Avison (2010), and highlight where our business model perspective helps to avoid conceptual ambiguity. The classification of the identified tensions is illustrated in Figure 3.



Category 1: Organizing Tensions

Organizing tensions in general arise as structuring and designing an organization creates contradictions among different organizational elements and processes (Smith and Lewis 2011). We identified seven tensions within the organizing category that span over the value architecture and value network dimensions. Table 1 gives an overview of the tensions that were identified by the literature review for the organizing category and provides definitions for each tension element along with management strategies.

Table 1. Organizing Tensions			
Authors	Tension (Dilemma or Paradox)	Definition of Elements (A and B)	Management Strategies (Either-Or=A or B, Both-And=A&B, More-Than=A∩B)
Ansari et al. (2016), Mantena and Saha (2012), Selander et al. (2010)	Competition vs. Cooperation (Clearly recognized as paradox in both platform and tension literatures)	A: Competition: Individuals act to maximize their own interest (Bengtsson and Kock 2000, p. 415) B: Cooperation: Individuals participate in collective actions to achieve common goals (Bengtsson and Kock 2000, p. 415)	<ul style="list-style-type: none"> A&B: Provide vision of future benefits, build critical mass of consumers, and simultaneously engage multiple incumbent platforms (Ansari et al. 2016) A&B: Provide direct, non-mediated access to member network for competitors (Mantena and Saha 2012)
Benlian et al. (2015), Boudreau (2010), Karhu et al. (2018), Wessel et al. (2017)	Control vs. Openness (Debated as paradox in tension literature but as dilemma in platform literature)	A: Openness: Easing the restrictions on the use, development, and commercialization of platform technologies (Boudreau 2010, p. 1851) B: Control: Mechanisms used by controllers in the attempt to influence controlees so that they act and behave in accordance with the controller’s objectives and goals (Wessel et al. 2017, p. 346)	<ul style="list-style-type: none"> A: Design boundary resources in ways to potentially retract from openness (Benlian et al. 2015; Karhu et al. 2018) B: Use soft control mechanisms (Wessel et al. 2017) A&B: Grant access rather than giving up control (Boudreau 2010)

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Cennamo (2018), Svahn et al. (2017)	In-house/Internal Development vs. Third-party/External Development (Not discussed in tension literature but debated as dilemma in platform literature)	A: In-house Development: Complements developed in-house by the platform provider (Cennamo 2018, p. 3045) B: Third-party Development: The extent a platform is supported by a narrow/broad set of external complementors (Cennamo 2018, p. 3044)	<ul style="list-style-type: none"> • A: Rely more heavily on internal development in early market stages (Cennamo 2018) • B: At later states, bring third-party developers on board but keep also producing some complements in-house (Cennamo 2018) • A&B: Engage in external collaboration with new partners (e.g., to access new revenue streams) while preserving cost-efficient coordination of internal resources (e.g., for competitive advantage) (Svahn et al. 2017)
Ghazawneh and Henfridsson (2013)	Securing vs. Resourcing (Not discussed in tension literature but debated as dilemma in platform literature)	A: Securing: The process by which the control of a platform and its related services is increased (p. 176) B: Resourcing: The process by which the scope and diversity of a platform is enhanced (p. 176)	<ul style="list-style-type: none"> • B: Self-resourcing (third-party developers create new boundary resources) • A: Regulation-based securing (platform owners' exercise of control through administrative legislation) • B: Diversity resourcing (platform owners' action to stimulate new application areas) • A: Sovereignty securing (platform owners' action to maintain single control)
Goldbach et al. (2018), Nielsen and Aanestad (2006), Tilson et al. (2010), Wareham et al. (2014), Ye and Kankanhalli (2018)	Control vs. Autonomy (Clearly recognized as paradox in both platform and tension literatures)	A: Control: A controller's attempts to influence a contreee to act according to the controller's objectives (Goldbach et al. 2018, p. 273) B: Autonomy: The extent to which individuals perceive that the platform allows them freedom and discretion to schedule work, make decisions, and choose methods for design and innovation (Ye and Kankanhalli 2018, p. 166)	<ul style="list-style-type: none"> • A: Use self-control/soft control mechanisms (Goldbach et al. 2018) • A: Graduated control in combination with self-selection of level of control (Wareham et al. 2014) • A: Retain control over architecture and devolve control over use (Nielsen and Aanestad 2006) • A: Definition and placement of sociotechnical control points (Tilson et al. 2010) • B: Grant autonomy regarding decision making and choosing methods (Ye and Kankanhalli 2018) • A&B: Reduce risk in specific areas (e.g., interoperability) via control of critical points to enable autonomous, option-creating responses to clients in other areas (e.g., functionality, services) (Wareham et al. 2014)
Gregory et al. (2015)	Standardization vs. Differentiation (Not discussed in tension literature but debated as paradox in platform literature)	A: Standardization: Focus on harmonization and consistent use of IT (p. 64) B: Differentiation: Focus on customization and flexible adaptation of IT to business needs (p. 64)	<ul style="list-style-type: none"> • A&B: Flexible recombination of standardized IT components according to differentiated business needs • A↑B: IT manager(s) formulate an important distinction between standardized IT platform core and flexibility in ensuring distinctive functionality at the periphery of the platform
Svahn et al. (2017)	Control vs. Flexibility (Debated as paradox in tension literature but as dilemma in platform literature)	A: Control: Prevailing authority structures and integration arrangements (p. 240) B: Flexibility: Exploration of digital options (p. 240)	<ul style="list-style-type: none"> • A&B: Provide an architecture for flexible integration with existing systems, while preventing unauthorized access to critical systems • A↑B: Design control mechanisms to enable flexible value co-creation

Besides these general observations in Table 1, our results indicate that devolving control creates tensions that affect different business model dimensions. On the one hand, the tensions between control and openness or control and flexibility affect the value network and value architecture dimensions. For example, Boudreau (2010) argues that devolving control via openness can be accomplished through enabling the use, development, and commercialization of the platform while retaining control over ecosystem actors. To manage this tension, Boudreau (2010) recommends to rather provide access than giving up control over the platform. On the contrary, the tension between control and autonomy affects the value network dimension. For example, Wareham et al. (2014) argue that granting autonomy for innovative responses to client requirements conflicts with retaining enough control over ecosystem actors. To balance this tension, they propose controlling critical points of the platform to ensure autonomous responses by complementors in other areas (e.g., to create functionality). While our results show that management strategies for the

tensions of control vs. openness or control vs. flexibility and control vs. autonomy are different (as these affect different business model dimensions) they share the commonality to retain control over the architecture and important control points (e.g., app stores) while devolving control over the use of the platform (Nielsen and Aanestad 2006; Tilson et al. 2010).

Interestingly, our findings regarding the organizing tension category reveal a chain of tensions that goes beyond dyadic relationships identified in previous tension literature (Gregory et al. 2015; Smith and Lewis 2011). This chain includes the tensions of (1) control vs. autonomy on the value network dimension, (2) control vs. openness on the value network and value architecture dimensions, and (3) control vs. flexibility that spans over the value network and value architecture dimensions.

Category 2: Performing Tensions

In general, organizing efforts often result in competing goals through divergent expectations of a plurality of actors (Smith 2014; Smith and Lewis 2011). We found four tensions of performing that arise over all four business model dimensions (i.e., value architecture, value network, value finance, and value proposition). Table 2 provides general information about the identified performing tensions.

Table 2. Performing Tensions			
Authors	Tension (Dilemma or Paradox)	Definition of Elements (A and B)	Management Strategies (Either-Or=A or B, Both-And=A&B, More-Than=A∩B)
Anderson et al. (2014), Cennamo et al. (2018)	Platform Performance/ Complexity vs. Development Costs (Not discussed in tension literature but debated as dilemma in platform literature)	A: Platform Performance/Complexity: The number of interdependent components of the platform’s core technology that interact with the platform’s complements through specialized interfaces (Cennamo et al. 2018, p. 2) B: Development Costs: Platform-specific costs of complementary innovation arising from the need to integrate a complement with a given platform architecture (Cennamo et al. 2018, p. 15)	<ul style="list-style-type: none"> • B: Offer incentives to exclusive complementors, produce exclusive complements itself, or facilitate co-marketing and co-development activities (Cennamo et al. 2018) • B: Understand the competitive environment, end user preferences, and needs of the developer community (Anderson et al. 2014)
Boudreau (2012)	Competitive Crowding vs. Network Effects (Not discussed in tension literature but debated as dilemma in platform literature)	A: Competitive Crowding: Incremental increases of complementors decrease innovation incentives (p. 1422) B: Network Effects: Adding more complementors encourages still more complementors by effectively expanding the market into which complementors sell their complements (p. 1411)	<ul style="list-style-type: none"> • B: Facilitate population-level diversity, variation, and experimentation and draw less on the heroic efforts of individual complementors
Cennamo (2018)	Quality vs. Variety (Not discussed in tension literature but debated as dilemma in platform literature)	A: Quality: The average level of consumption benefits (p. 3042) B: Variety: The number and diversity of complements available for the platform (p. 3041)	<ul style="list-style-type: none"> • B: Invest in boundary resources (e.g., APIs or SDKs) or marketing activities to support value co-creation with complementors in early market stages • A: Later on, technological superiority could increase quality
Huber et al. (2017)	Governance Costs vs. Co-created Value (Not discussed in tension literature but debated as paradox in platform literature)	A: Governance Costs: The effort borne by the partners arising from planning, adapting, and safeguarding the resources contributed to the partnership (p. 567) B: Co-created Value: The tangible and intangible benefits resulting from the combination of resources of the partners (p. 567)	<ul style="list-style-type: none"> • A&B: Initially execute rules (that regulate how and under what conditions complementors are granted access to the platform owner’s resources) passively but execute and stretch rules later while emphasizing values

In addition to these general findings, our results reveal an interesting interrelationship between the goals of providing high platform performance at the core and providing high quality regarding the platform core *and* complements. While the goals of having high quality complements conflicts with variety of the platform architecture, platform performance affects development costs on the value finance dimension. For example,

Anderson et al. (2014) use platform performance as a vertically differentiated dimension of platform quality that often conflicts with complementors development costs through the need to integrate a complement with a given platform architecture. Anderson et al. (2014) and Cennamo et al. (2018) propose that platform owners have to either produce exclusive complements by themselves or offer co-creation support (e.g., marketing resources) to manage this tension. On the other hand, Cennamo (2018) views platform performance as the quality of complements that contributes to overall platform performance. Cennamo (2018) argues that quality impedes the variety of complements. To manage this tension, it is proposed to invest in boundary and marketing resources in the early stage of the platform while technological performance of the platform core increases complement quality and variety later on (Cennamo 2018).

Also, our results show that tensions regarding costs of the platform owner *and* complementors on the value finance dimension are interlinked. While development costs for complementors conflict with platform performance on the value architecture dimension, governance costs for platform owners *and* complementors arise that conflict with the need to combine resources of partners (i.e., the platform owner and complementors) to offer a coherent value proposition (i.e., co-created value). For example, Huber et al. (2017) show that governance costs arise for both the platform owner and complementors through formal safeguarding costs (e.g., negotiating and drafting contracts). To achieve low governance costs for the platform owner and complementors while enabling high co-created value, Huber et al. (2017) emphasize to strictly follow rules that govern the granted access to the platform owner’s resources (e.g., marketing resources) early in the partnership but later on stretch rules while emphasizing values to enable co-creation.

Our results of the performing tension category imply that the tensions of (1) variety vs. quality on the value architecture, (2) platform performance vs. complement development costs on the value architecture and value finance dimensions, and (3) governance costs vs. co-created value on the value finance and value proposition dimensions are interlinked. Thus, contrary to chains with two tensions observed in the previous subsection, these tensions may form chains with three tensions.

Category 3: Learning Tensions

Besides competing goals of different actors, tensions of learning generally arise through destroying past practices to create new innovations (Lewis 2000; Smith and Lewis 2011). We observed four tensions of learning that affect all four business model dimensions (i.e., value architecture, value network, value finance, and value proposition). Table 3 summarizes general findings for the identified learning tensions.

Table 3. Learning Tensions			
Authors	Tension (Dilemma or Paradox)	Definition of Elements (A and B)	Management Strategies (Either-Or=A or B, Both-And=A&B, More-Than=A∩B)
Jain and Ramesh (2015)	Stability vs. Generativity (Not discussed in tension literature but debated as paradox in platform literature)	A: Stability: The installed base and its ossified nature and content in terms of social and technical components and their connections (Tilson et al. 2010, p. 754) B: Generativity: The ability of any self-contained system to create, generate, or produce a new output, structure, or behavior without any input from the originator of the system (Tilson et al. 2010, p. 750)	<ul style="list-style-type: none"> A∩B: Facilitate boundary-spanning activities and the development of boundary objects/resources A&B: Continuously monitor and adjust the platform
Rolland et al. (2018)	Digital Debt vs. Digital Options (Not discussed in tension literature but debated as paradox in platform literature)	A: Digital Debt: A buildup of technical and informational obligations related to platform maintenance and evolvability that represent performance risks in an organization’s work processes (p. 7) B: Digital Options: An opportunity to invest in new technical and informational features that will increase the platform’s value proposition for an organization’s work processes (p. 7)	<ul style="list-style-type: none"> B: Identify, develop, and realize digital options A: Plant, evaluate, and resolve digital debt A&B: Iteratively resolve debt to develop options, plant debt to realize options, or leverage options to resolve debt

Svahn et al. (2017)	Existing Capability vs. Requisite Capability (Debated as paradox in tension literature but as dilemma in platform literature)	A: Existing Capability: Existing innovation practices (p. 239) B: Requisite Capability: Development of new innovation capabilities (p. 239)	<ul style="list-style-type: none"> A&B: Develop capability to empower independent developers while firm is organized for upfront specification of end user functionality
Woodard et al. (2013)	Short-term Value Appropriation vs. Long-term Value Creation (Debated as paradox in tension literature but as dilemma in platform literature)	A: Short-term Value Appropriation: Short-term opportunities for capturing economic value (p. 542) B: Long-term Value Creation: Long-term path of design evolution (p. 542)	<ul style="list-style-type: none"> A&B: Investing to delay full-scale commitment while preserving the ability to act quickly (via boundary resources)

Surprisingly, the literature review findings indicate that the four identified tensions of learning are interlinked, sharing the fundamental tension between long-term thinking and short-term actions. For example, Rolland et al. (2018) observe that digital debt could constrain the development and realization of digital options while digital options often create additional digital debt resulting in a tension. They argue that developing and realizing digital options leverages the generativity of the platform in the long-term. Rolland et al. (2018) recommend to systematically identify, develop, and realize digital options in the long-term while planting, evaluating, and resolving digital debt in the short-term to leverage generativity. In addition, Svahn et al. (2017) argue that to exploit digital options, platforms must develop requisite capabilities and long-term visions for new innovations without jeopardizing existing capabilities and short-term commitments that are centered on in-house development. To balance the tension between existing and requisite capabilities, Svahn et al. (2017) propose to both have the capability to empower complementors but also to be organized for upfront specification of end user functionality.

While the identified tensions of (1) generativity vs. stability on the value architecture dimension, (2) digital options vs. digital debt on the value finance dimension, (3) long-term value creation vs. short-term value appropriation on the value proposition dimension, and (4) requisite capabilities vs. existing capabilities on the value network dimension relate to different business model dimensions, they share links to each other and may therefore form a chain of tensions when combining them.

Category 4: Belonging Tensions

Generally, learning often creates tensions of belonging that surface when identities or interpersonal relationships clash (Smith and Lewis 2011). We identified two tensions of belonging that are centered on the value network dimension. Table 4 provides general observations about the found belonging tensions.

Authors	Tension (Dilemma or Paradox)	Definition of Elements (A and B)	Management Strategies (Either-Or=A or B, Both-And=A&B, More-Than=A∩B)
Lindgren et al. (2015)	Old Identity vs. New Identity (Clearly recognized as paradox in both platform and tension literatures)	A: Old vs. B: New Organizational Identity: A set of mutually shared and enforced expectations, norms about what is the 'core' of an organization and what consequently constitutes a range of legitimate behaviors for that organization (p. 230)	<ul style="list-style-type: none"> A&B: Craft new roles and establish novel relationships to cooperate in new ways while changing internal norms, values, and power structures
Wareham et al. (2014)	Individual vs. Collective (Clearly recognized as paradox in both platform and tension literatures)	A: Individual: Self-interested behavior (p. 1206) B: Collective: Contributions to the social goods of the ecosystem (p. 1199)	<ul style="list-style-type: none"> A&B: Individual services/currencies and communal resources/socialization to common behavioral norms (via status)

Interestingly, we can observe from our findings that tensions that arise when old identities of platforms change towards new identities are interlinked with the tension between individual and collective identifications of ecosystem actors. For example, Lindgren et al. (2015) observe that when the *identity* of a platform changes, tensions emerge that inhibit the normative ground with which ecosystem actors can

identify with. To manage these tensions, Lindgren et al. (2015) and Wareham et al. (2014) propose to create new roles and relationships for cooperation with other ecosystem actors or to change values.

Our findings imply that when the tensions of (1) old identity vs. new identity and (2) individual vs. collective are considered with respect to each other they may form a chain of tensions.

Tensions across Categories

Thus far, we have seen tensions on digital platforms that operate within distinct categories of tensions. However, we found four tensions that operate across these categories (Smith and Lewis 2011) and affect the value architecture, value network, and value finance dimensions. Table 5 gives an overview of the identified tensions and indicates which categories of tensions are affected.

Table 5. Tensions across Categories				
Authors	Tension (Dilemma or Paradox)	Definition of Elements (A and B)	Management Strategies (Either-Or=A or B, Both-And=A&B, More-Than=A^B)	Categories of Tensions
Eaton et al. (2015)	Control vs. Generativity (Not discussed in tension literature but debated as paradox in platform literature)	A: Control: Influence different forms of standards to manage access to the service system (Eaton et al. 2015, p. 219) B: Generativity: A technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences (Zittrain 2006, p. 1980)	<ul style="list-style-type: none"> A^B: Allow individual actors and artifacts to co-create and tune boundary resources via overlapping actions of resistance and accommodation 	A: Organizing vs. B: Learning
Parker and Van Alstyne (2018)	Ability to Charge vs. Openness (Debated as paradox in tension literature but as dilemma in platform literature)	A: Ability to Charge: Charge for platform access (p. 3015) B: Openness: A platform is more "open" to the extent that it places fewer restrictions on participation, development, or use across its distinct roles, whether for developer or end user (p. 3018)	<ul style="list-style-type: none"> A^B: Share developer innovations with the ecosystem to spur further innovation (via spillover effects) while designing control mechanisms to safeguard such spillovers and enable profits for the whole ecosystem 	A: Performing vs. B: Organizing
Tilson et al. (2010)	Stability vs. Flexibility (Clearly recognized as paradox in both platform and tension literatures)	A: Stability: The installed base and its ossified nature and content in terms of social and technical components and their connections (p. 754) B: Flexibility: Upward flexibility i.e., open to the creation of any application or service making use of its lower level communications and storage capabilities; downward flexibility i.e., a wide range of digital or physical networks potentially can provide the required interconnectivity and other functions (p. 752)	<ul style="list-style-type: none"> A: Social stability is needed to reach and disseminate agreements about necessary interfaces, data definitions, and their evolution 	A: Learning vs. B: Organizing
Wareham et al. (2014)	Standard vs. Variety (Not discussed in tension literature but debated as paradox in platform literature)	A: Standard: Standardization of the core (p. 1197) B: Variety: Creation of specialized complements and constant experimentation (p. 1197)	<ul style="list-style-type: none"> A: Processes and tools focused on technical standards and quality (for compatibility) B: Make the platform core open-source to permit customization A&B: Provide predictable standards while communicating the evolution path of the platform core to maintain compatibility over time 	A: Organizing vs. B: Performing

Our examination reveals that the chain of tensions related to devolving control (i.e., control vs. autonomy, control vs. openness, and control vs. flexibility) in the organizing category can be extended by the tension between openness and ability to charge on the value finance dimension (Parker and Van Alstyne 2018). To manage this tension, Parker and Van Alstyne (2018) propose to share complements with the ecosystem to spur spillover effects while designing control mechanisms to safeguard these spillover effects.

In addition, organizing tensions of standardization and differentiation are interlinked and form a chain with the performing goals of variety and quality of complements. Wareham et al. (2014) identify the tension between standardization and constant experimentation for the creation of a variety of complements. They argue that without standardization of the platform core and interfaces, complement quality and variety is limited due to the lack of sharing reusable code and redundancies. They recommend implementing processes and tools to facilitate compatibility between complements and the platform core.

So far, we found chains of tensions that emerge within and across different business model dimensions or categories of tensions. Surprisingly, our results also point to a cycle of tensions that emerges between tensions of (1) control vs. flexibility, (2) stability vs. flexibility, (3) stability vs. generativity, and (4) control vs. generativity and spans the organizing and learning tension categories. For example, Eaton et al. (2015) examine the tension between control and generativity that connects the value network and value architecture dimensions and propose to allow complementors to resist and accommodate boundary resources and adjust them accordingly. In addition, Tilson et al. (2010) examine the tension between stability and flexibility. This tension cycle is closed by the organizing tension of control vs. flexibility (Svahn et al. 2017) and the learning tension of stability vs. generativity (Jain and Ramesh 2015).

Discussion and Conclusion

In this paper we described what set of interrelated tensions platform owners face when continuously designing, adapting, and/or redesigning their digital platform business model. Based on a structured literature review, the identified tensions were classified into four different categories of tensions (based on Smith and Lewis (2011)) and into four distinct business model dimensions (based on Al-Debei and Avison (2010)). In sum, we provide a type I theory for analyzing (cf. Gregor 2006) tensions in digital platform business models. In the following we discuss our findings with respect to (1) the literature on digital business models and (2) the literature on digital platforms.

First, we contribute to business model research by enriching past conversations in digital business model studies which emphasize different and often conflicting elements that have to be managed (Al-Debei and Avison 2010; Smith et al. 2010; Zott and Amit 2007). To investigate conflicting elements that often create tensions, we instantiate the business model framework of Al-Debei and Avison (2010) and transfer it to the context of digital platforms by classifying different tensions found in the digital platform literature into four distinct business model dimensions (Al-Debei and Avison 2010). The application of this framework to the digital platform context shows that all four dimensions are affected by tensions (Al-Debei and Avison 2010). In particular, our findings suggest that when platform owners aim to manage tensions regarding the tension categories of learning and performing (cf. Smith and Lewis 2011), they should consider all four business model dimensions (i.e., value architecture, value network, value finance, and value proposition). When platform owners aim to manage tensions regarding organizing and belonging, the focus should be on the value architecture and value network dimensions.

Second, with regard to the literature on digital platforms, our findings help to avoid conceptual ambiguity (see the previous section for examples). In addition, we can observe chains of tensions from our literature review findings that cross different business model dimensions and potentially lead to “complex situations of paradoxical triangles or even quadruples” (Gregory et al. 2015, p. 76). Managing such chains of tensions implies that responding to one tension may enable coping with related tensions (Luscher and Lewis 2008). For example, as one chain traverses through the business model dimensions value finance, value architecture, and value network, platform owners might derive appropriate management strategies with respect to these three business model dimensions. In addition, a particularly interesting finding of our literature review are cycles of tensions. These cycles of tensions arise when multiple tension elements are connected within or across different categories of tensions and business model dimensions but form a closed sequence. We assume that these cycles may require more intricate management strategies (e.g.,

more-than strategies) that transcend traditional both-and responses to tensions. Finally, when cycles or chains of tensions are connected together, they may form a network of tensions.

Opportunities for future research arise when considering the boundary conditions and limitations of this study. First and foremost, we seek to answer the “what” question regarding tensions in digital platform business models but remain virtually silent about “how” and “why” these tensions emerge. Additional valuable theoretical contributions could be obtained by answering these “how” and “why” questions (Whetten 1989). Furthermore, this study is bounded by the focus on platform owners who face tensions when managing their digital platform business model. Though, our results indicate that the management of tensions in digital platform business models is often not under the full discretion of platform owners because also other ecosystem actors like complementors or end users are affected by tensions (e.g., performing tensions often arise through conflicting goals between platform owners and complementors). Hence, future research could focus on other ecosystem actors such as complementors or end users or divide the role of the platform owner to examine platform sponsors or platform providers individually. Additionally, future research can extend our findings regarding management strategies for single tensions (see Tables 1 - 5 for examples) by examining how chains or cycles of tensions could be managed. For example, future studies could make use of the compatible underlying assumptions of business models and tensions to derive management strategies for chains or cycles of tensions that affect different business model dimensions. Our results further reveal that most tensions can be found on the value architecture and value network dimensions and these two business model dimensions accommodate all four categories of tensions (i.e., learning, belonging, organizing, and performing). Thus, perhaps new categories of tensions emerge, especially across and within the value architecture and value network dimensions. However, we dedicate the discovery of new categories of tensions to future research (see, for example, Chae et al. (2005) in the context of knowledge management). Furthermore, some of the identified tensions may be more universal while others may be more idiosyncratic to digital platforms (such as the tension between control and generativity which has not yet been examined in the tension literature). Additionally, while tension literature considered certain tensions as paradox (e.g., the tension between control and openness), digital platform literature treats them as ordinary dilemmas. Therefore, future research could investigate context-specifics of tensions and the manifestation of tensions as paradox on digital platforms. Finally, future studies could use the theory for analyzing with an business model framework (cf. Al-Debei and Avison 2010) proposed in this study or consider other frameworks (see, for example, Tiwana et al. (2010)) when studying tensions on digital platforms.

Despite these limitations and boundary conditions of our results, especially platform owners can gain practical utility from our findings. We guide them through the challenging endeavor of continuously designing, adapting, and/or redesigning the business model for their digital platform by making them aware of what set of interrelated tensions they have to manage for a successful and sustaining business model. In addition, we show chains and cycles between tensions that point to possible ripple effects that emerge when they manage one tension to the detriment of another. Consider our introductory example of Google’s Android platform. Our results provide management strategies for companies that experience similar challenges as Google in the infancy of its Android platform.

In conclusion, past scholarly discussions about business models and tensions largely took place in isolation, despite their compatible assumptions. We combined these perspectives and applied the integrated perspective to the digital platform context. We were able to identify 21 tensions that are relevant when platform owners want to manage their digital platform business model. The classification of the identified tensions into different categories of tensions and business model dimensions allowed us to point out which business model dimensions are rich with tensions. In addition, our findings help to avoid conceptual ambiguity and reveal chains and cycles between tensions for digital platform research.

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References

- Adner, R. 2006. "Match Your Innovation Strategy to Your Innovation Ecosystem," *Harvard Business Review* (84:4), pp. 98-107.
- Adner, R. 2017. "Ecosystem as Structure: An Actionable Construct for Strategy," *Journal of Management* (43:1), pp. 39-58.
- Afuah, A., and Tucci, C. 2003. *Internet Business Models and Strategies*, (2 ed.). New York: McGraw-Hill.
- Al-Debei, M. M., and Avison, D. 2010. "Developing a Unified Framework of the Business Model Concept," *European Journal of Information Systems* (19:3), pp. 359-376.
- Anderson, E. G., Parker, G. G., and Tan, B. 2014. "Platform Performance Investment in the Presence of Network Externalities," *Information Systems Research* (25:1), pp. 152-172.
- Andriopoulos, C., and Lewis, M. W. 2009. "Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation," *Organization Science* (20:4), pp. 696-717.
- Ansari, S. S., Garud, R., and Kumaraswamy, A. 2016. "The Disruptor's Dilemma: Tivo and the U.S. Television Ecosystem," *Strategic Management Journal* (37:9), pp. 1829-1853.
- Baldwin, C. Y., and Woodard, C. J. 2009. "The Architecture of Platforms: A Unified View," in: *Platforms, Markets and Innovation*, A. Gawer (ed.). London: Edward Elgar Publishing, pp. 19-44.
- Bengtsson, M., and Kock, S. 2000. "'Coopetition' in Business Networks - to Cooperate and Compete Simultaneously," *Industrial Marketing Management* (29:5), pp. 411-426.
- Benlian, A., Hilkert, D., and Hess, T. 2015. "How Open Is This Platform? The Meaning and Measurement of Platform Openness from the Complementors' Perspective," *Journal of Information Technology* (30:3), pp. 209-228.
- Boudreau, K. J. 2010. "Open Platform Strategies and Innovation: Granting Access Vs. Devolving Control," *Management Science* (56:10), pp. 1849-1872.
- Boudreau, K. J. 2012. "Let a Thousand Flowers Bloom? An Early Look at Large Numbers of Software App Developers and Patterns of Innovation," *Organization Science* (23:5), pp. 1409-1427.
- Boudreau, K. J., and Lakhani, K. R. 2009. "How to Manage Outside Innovation," *MIT Sloan Management Review* (50:4), pp. 69-76.
- Brandenburger, A., and Nalebuff, B. 1996. *Co-Opetition*, (1 ed.). New York: Doubleday.
- Cennamo, C. 2018. "Building the Value of Next-Generation Platforms: The Paradox of Diminishing Returns," *Journal of Management* (44:8), pp. 3038-3069.
- Cennamo, C., Ozalp, H., and Kretschmer, T. 2018. "Platform Architecture and Quality Trade-Offs of Multihoming Complements," *Information Systems Research* (29:2), pp. 461-478.
- Chae, B., Koch, H., Paradise, D., and Van Huy, V. 2005. "Exploring Knowledge Management Using Network Theories: Questions, Paradoxes and Prospects," *Journal of Computer Information Systems* (45:4), pp. 62-74.
- Ciborra, C. U. 1996. "The Platform Organization: Recombining Strategies, Structures, and Surprises," *Organization Science* (7:2), pp. 103-118.
- de Reuver, M., Sørensen, C., and Basole, R. C. 2018. "The Digital Platform: A Research Agenda," *Journal of Information Technology* (33:2), pp. 124-135.
- Demil, B., and Lecocq, X. 2010. "Business Model Evolution: In Search of Dynamic Consistency," *Long Range Planning* (43:2-3), pp. 227-246.
- Dowie, J., Henningsson, S., Kude, T., and Popp, K. 2017. "Merging Platform Ecosystems in Technology Acquisitions: A Governance Perspective," *25th European Conference on Information Systems*, Guimarães.
- Eaton, B., Elaluf-Calderwood, S., Sørensen, C., and Yoo, Y. 2015. "Distributed Tuning of Boundary Resources: The Case of Apple's Ios Service System," *MIS Quarterly* (39:1), pp. 217-244.
- Eisenmann, T. R. 2008. "Managing Proprietary and Shared Platforms," *California Management Review* (50:4), pp. 31-53.
- Eisenmann, T. R., Parker, G. G., and Van Alstyne, M. W. 2006. "Strategies for Two-Sided Markets," *Harvard Business Review* (84:10), pp. 92-101.
- Fichman, R. G. 2004. "Real Options and It Platform Adoption: Implications for Theory and Practice," *Information Systems Research* (15:2), pp. 132-154.
- Gawer, A. 2014. "Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework," *Research Policy* (43:7), pp. 1239-1249.

- Ghazawneh, A., and Henfridsson, O. 2013. "Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model," *Information Systems Journal* (23:2), pp. 173-192.
- Gibson, C. B., and Birkinshaw, J. 2004. "The Antecedents, Consequences, and Mediating Role of Organizational Ambidexterity," *Academy of Management Journal* (47:2), pp. 209-226.
- Goldbach, T., Benlian, A., and Buxmann, P. 2018. "Differential Effects of Formal and Self-Control in Mobile Platform Ecosystems: Multi-Method Findings on Third-Party Developers' Continuance Intentions and Application Quality," *Information and Management* (55:3), pp. 271-284.
- Gregor, S. 2006. "The Nature of Theory in Information Systems," *MIS Quarterly* (30:3), pp. 611-642.
- Gregory, R. W., Keil, M., Muntermann, J., and Mahrng, M. 2015. "Paradoxes and the Nature of Ambidexterity in It Transformation Programs," *Information Systems Research* (26:1), pp. 57-80.
- Hedman, J., and Kalling, T. 2003. "The Business Model Concept: Theoretical Underpinnings and Empirical Illustrations," *European Journal of Information Systems* (12:1), pp. 49-59.
- Huber, T. L., Kude, T., and Dibbern, J. 2017. "Governance Practices in Platform Ecosystems: Navigating Tensions between Cocreated Value and Governance Costs," *Information Systems Research* (28:3), pp. 563-584.
- Hurni, T., and Huber, T. 2014. "The Interplay of Power and Trust in Platform Ecosystems of the Enterprise Application Software Industry," *22nd European Conference on Information Systems*, Tel Aviv.
- Iansiti, M., and Levien, R. 2004. "Strategy as Ecology," *Harvard Business Review* (82:3), pp. 68-78.
- Jacobides, M. G., Cennamo, C., and Gawer, A. 2018. "Towards a Theory of Ecosystems," *Strategic Management Journal* (39:8), pp. 2255-2276.
- Jain, R. P., and Ramesh, B. 2015. "The Roles of Contextual Elements in Post-Merger Common Platform Development: An Empirical Investigation," *European Journal of Information Systems* (24:2), pp. 159-177.
- Kallinikos, J., Aaltonen, A., and Marton, A. 2013. "The Ambivalent Ontology of Digital Artifacts," *MIS Quarterly* (37:2), pp. 357-370.
- Karhu, K., Gustafsson, R., and Lyytinen, K. 2018. "Exploiting and Defending Open Digital Platforms with Boundary Resources: Android's Five Platform Forks," *Information Systems Research* (29:2), pp. 253-523.
- Kazan, E., Tan, C.-W., Lim, E. T. K., Sørensen, C., and Damsgaard, J. 2018. "Disentangling Digital Platform Competition: The Case of Uk Mobile Payment Platforms," *Journal of Management Information Systems* (35:1), pp. 180-219.
- Leidner, D. E., and Kayworth, T. 2006. "Review: A Review of Culture in Information Systems Research: Toward a Theory of Information Technology Culture Conflict," *MIS Quarterly* (30:2), pp. 357-399.
- Lewis, M. W. 2000. "Exploring Paradox: Toward a More Comprehensive Guide," *Academy of Management Review* (25:4), pp. 760-776.
- Lindgren, R., Eriksson, O., and Lyytinen, K. 2015. "Managing Identity Tensions During Mobile Ecosystem Evolution," *Journal of Information Technology* (30:3), pp. 229-244.
- Luscher, L. S., and Lewis, M. W. 2008. "Organizational Change and Managerial Sensemaking: Working through Paradox," *Academy of Management Journal* (51:2), pp. 221-240.
- Mantena, R., and Saha, R. 2012. "Co-Opetition between Differentiated Platforms in Two-Sided Markets," *Journal of Management Information Systems* (29:2), pp. 109-140.
- Moore, J. E. 1996. *The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems*, (1 ed.). New York: HarperBusiness.
- Nielsen, P., and Aanestad, M. 2006. "Control Devolution as Information Infrastructure Design Strategy: A Case Study of a Content Service Platform for Mobile Phones in Norway," *Journal of Information Technology* (21:3), pp. 185-194.
- Nischak, F., Hanelt, A., and Kolbe, L. M. 2018. "Unraveling the Interaction of Information Systems and Ecosystems - a Comprehensive Classification of Literature," *38th International Conference on Information Systems*, Seoul.
- Parker, G. G., and Van Alstyne, M. W. 2018. "Innovation, Openness, and Platform Control," *Management Science* (64:7), pp. 3015-3032.
- Poole, M. S., and van de Ven, A. H. 1989. "Using Paradox to Build Management and Organization Theories," *Academy of Management Review* (14:4), pp. 562-578.
- Putnam, L. L., Fairhurst, G. T., and Banghart, S. 2016. "Contradictions, Dialectics, and Paradoxes in Organizations: A Constitutive Approach," *Academy of Management Annals* (10:1), pp. 65-171.

- Rolland, K. H., Mathiassen, L., and Rai, A. 2018. "Managing Digital Platforms in User Organizations: The Interactions between Digital Options and Digital Debt," *Information Systems Research* (29:2), pp. 419-443.
- Schreieck, M., Wiesche, M., and Krcmar, H. 2016. "Design and Governance of Platform Ecosystems - Key Concepts and Issues for Future Research," *24th European Conference on Information Systems*, Istanbul.
- Selander, L., Henfridsson, O., and Svahn, F. 2010. "Transforming Ecosystem Relationships in Digital Innovation," *31st International Conference on Information Systems*, St. Louis.
- Smith, W. K. 2014. "Dynamic Decision Making: A Model of Senior Leaders Managing Strategic Paradoxes," *Academy of Management Journal* (57:6), pp. 1592-1623.
- Smith, W. K., Binns, A., and Tushman, M. L. 2010. "Complex Business Models: Managing Strategic Paradoxes Simultaneously," *Long Range Planning* (43:2-3), pp. 448-461.
- Smith, W. K., Gonin, M., and Besharov, M. L. 2013. "Managing Social-Business Tensions: A Review and Research Agenda for Social Enterprise," *Business Ethics Quarterly* (23:3), pp. 407-442.
- Smith, W. K., and Lewis, M. W. 2011. "Toward a Theory of Paradox: A Dynamic Equilibrium Model of Organizing," *Academy of Management Review* (36:2), pp. 381-403.
- Smith, W. K., and Tushman, M. L. 2005. "Managing Strategic Contradictions: A Top Management Model for Managing Innovation Streams," *Organization Science* (16:5), pp. 522-536.
- Svahn, F., Mathiassen, L., and Lindgren, R. 2017. "Embracing Digital Innovation in Incumbent Firms: How Volvo Cars Managed Competing Concerns," *MIS Quarterly* (41:1), pp. 239-253.
- Teece, D. J. 2010. "Business Models, Business Strategy and Innovation," *Long Range Planning* (43:2-3), pp. 172-194.
- Tilson, D., Lyytinen, K., and Sørensen, C. 2010. "Digital Infrastructures: The Missing Is Research Agenda," *Information Systems Research* (21:4), pp. 748-759.
- Tiwana, A., Konsynski, B., and Bush, A. A. 2010. "Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics," *Information Systems Research* (21:4), pp. 675-687.
- Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Spann, M., Kundisch, D., Leimeister, J. M., and Loos, P. 2014. "Business Models: An Information Systems Research Agenda," *Business and Information Systems Engineering* (6:1), pp. 45-53.
- vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., and Cleven, A. 2009. "Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process," *17th European Conference on Information Systems*, Verona.
- vom Brocke, J., Simons, A., Riemer, K., Niehaves, B., Plattfaut, R., and Cleven, A. 2015. "Standing on the Shoulders of Giants: Challenges and Recommendations of Literature Search in Information Systems Research," *Communications of the Association for Information Systems* (37:1), pp. 205-224.
- Wareham, J., Fox, P. B., and Cano Giner, J. L. 2014. "Technology Ecosystem Governance," *Organization Science* (25:4), pp. 1195-1215.
- Webster, J., and Watson, R. T. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), pp. xiii-xxiii.
- Wessel, M., Thies, F., and Benlian, A. 2017. "Opening the Floodgates: The Implications of Increasing Platform Openness in Crowdfunding," *Journal of Information Technology* (32:4), pp. 344-360.
- Whetten, D. A. 1989. "What Constitutes a Theoretical Contribution?," *Academy of Management Review* (14:4), pp. 490-495.
- Woodard, C. J., Ramasubbu, N., Tschang, F. T., and Sambamurthy, V. 2013. "Design Capital and Design Moves: The Logic of Digital Business Strategy," *MIS Quarterly* (37:2), pp. 537-564.
- Ye, H. J., and Kankanhalli, A. 2018. "User Service Innovation on Mobile Phone Platforms: Investigating Impacts of Lead Userness, Toolkit Support, and Design Autonomy," *MIS Quarterly* (42:1), pp. 165-187.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. 2010. "The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research," *Information Systems Research* (21:4), pp. 724-735.
- Zittrain, J. L. 2006. "The Generative Internet," *Harvard Law Review* (119:7), pp. 1974-2040.
- Zott, C., and Amit, R. 2007. "Business Model Design and the Performance of Entrepreneurial Firms," *Organization Science* (18:2), pp. 181-199.
- Zott, C., and Amit, R. 2010. "Business Model Design: An Activity System Perspective," *Long Range Planning* (43:2-3), pp. 216-226.
- Zott, C., Amit, R., and Massa, L. 2011. "The Business Model: Recent Developments and Future Research," *Journal of Management* (37:4), pp. 1019-1042.

Essay 2: Autonomy and Alignment in Platform-based Meta-organizations: A Qualitative Meta-analysis

Authors: Tobias Mini, University of Passau, Germany
Thomas Widjaja, University of Passau, Germany
Robert W. Gregory, University of Miami, USA

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Abstract

Meta-organizations leverage the unique architecture of digital technologies to align autonomous actors with system-level goals without relying on formal contractual or managerial authority. Motivated by the fact that meta-organizations are unique and distinct from traditional organizations, we seek to understand the key mechanisms enabled by digital technology for synthesizing autonomy and alignment in non-hierarchical meta-organizations. For this purpose, we employed a qualitative meta-analysis of 16 case studies on platform-based meta-organizations published in Information Systems. We identified eight mechanisms enabled by digital technology that synthesize autonomy and alignment in non-hierarchical meta-organizations. The identified mechanisms were classified into an a-priori derived framework consisting of two dimensions: (1) autonomy that can be taken for granted or granted by the owner of the platform-based meta-organization; and (2) alignment that can be core-driven or periphery-driven. With these preliminary findings we expect to contribute to the literatures on new forms of organizing and platform-based meta-organizations.

Autonomy and Alignment in Platform-based Meta-organizations: A Qualitative Meta-analysis

PDW – Research in Progress

Tobias Mini
(Ph.D. Student)

University of Passau
Chair of Business Information Systems
tobias.mini@uni-passau.de

Thomas Widjaja
(Faculty Member)

University of Passau
Chair of Business Information Systems
thomas.widjaja@uni-passau.de

Robert Gregory
(Faculty Member)

University of Virginia
McIntire School of Commerce
rg7cv@comm.virginia.edu

1. Introduction

Meta-organizations leverage the unique properties and architecture of digital technologies to solve the problem of organizing within distributed networks of autonomous actors without relying on formal contractual or managerial authority while at the same time ensuring alignment with system-level goals (Boudreau 2012; Cennamo and Santaló 2019; Eaton et al. 2015; Gawer 2014; Gulati et al. 2012; Yoo et al. 2010). For example, Uber utilizes algorithms on its platform to match and control riders and drivers while granting them high flexibility and autonomy. As another example, Topcoder brings together autonomous software developers on its platform to solve complex software problems defined by firms and organizes competitions where developers compete for the best solution to win monetary prizes and gain status. The phenomenon of meta-organizations as a new form of organizing is quickly attracting more public interest and scholarly attention with the rise of the so-called gig economy and the establishment of online labor platforms such as Upwork, TaskRabbit, M-Turk, and Uber, where work is being organized with the help of algorithms and other digital technologies on platforms (Ashford et al. 2018; Burtch et al. 2018; Cappelli and Keller 2013; Chen and Horton 2016; Curchod et al. 2019; Faraj et al. 2018; Huang et al. 2020; Kuhn and Maleki 2017; Petriglieri et al. 2018; Rosenblat and Stark 2016; Wood et al. 2019).

Meta-organizations are unique and distinct from traditional organizations in at least three fundamental ways. First, the autonomy of actors in the distributed network of the platform supplying labor or complementary goods is typically high in meta-organizations. This is based on one of the fundamental assumptions of the platform-based networked information economy, where autonomy is defined as the practical capacities of individual actors to create more value for and by themselves, and in loose commonality with others (Benkler 2006). While not all meta-organizations fully leverage the potentials of autonomous platform workers, meta-organizations generally exhibit higher potential for the democratization of innovation, where users are empowered to participate more directly in value co-creation efforts based on their autonomy and capacities (von Hippel 2005). Second, meta-organizations are different from traditional organizations in that relational architectures are non-hierarchical. Drawing on another general assumption underlying the networked information economy that has created the context for the rise of meta-organizations, platform workers are not constrained to organize their relationship in traditional hierarchical models of social and economic organization (Benkler 2006), which have served as the foundation for traditional large and bureaucratic organizations in the pre-digital industrial era (Chandler 1962; Gouldner 1954). Third, meta-organizations leverage the advancements in the evolution of digital technology (Yoo et al. 2010), including but not limited to the layered-modular architecture that

distinguishes between a core and a periphery (Gawer 2014), the new possibilities for collecting and learning from data collected on each user of the platform (Gregory et al. 2020), and algorithms that predict job opportunities and prescribe how work should be executed (Rosenblat and Stark 2016; Wood et al. 2019).

Juxtaposing the first and second characteristic of meta-organizations highlighted above raises the important question of how platform-based meta-organizations achieve both autonomy and alignment at the same time while relinquishing bureaucratic control as known from traditional hierarchy-based organizations? Adding the third characteristic to the establishment of the phenomenon leads to the following research question: *What are the key mechanisms enabled by digital technology for synthesizing autonomy and alignment in non-hierarchical meta-organizations?*

We defined autonomy above as the practical capacities of individual actors to create more value for and by themselves, and in loose commonality with others (Benkler 2006). We define alignment as the federation and coordination of constitutive actors distributed across the platform network to ensure ecosystem-wide optimal matching of supply and demand, desirable innovation, or behavioral congruence with the economic vision and cultural expectations set by the platform owner and its direct stakeholders (Gawer 2014). The purpose of this paper is to shed light on the mechanisms that leverage digital technology for achieving both autonomy and alignment at the same time, without relying on traditional forms of formal authority (e.g., hierarchical, managerial, contractual).

The research method is a qualitative meta-analysis (e.g., Berente et al. 2019; Combs et al. 2019; Habersang et al. 2019; Hoon 2013; Noblit and Hare 1988). A systematic qualitative meta-analysis of empirical studies in this burgeoning area of interest is important and timely for the following two reasons. First, while the unique characteristics of meta-organizations as a new form of organizing differ substantially from the characteristics of large organizations—e.g., as highlighted above, large organizations typically rely on bureaucratic command-and-control mechanisms implemented by authoritative managers in the hierarchy while meta-organizations focus on mechanisms that connect-and-coordinate autonomous actors without trapping them in an ‘iron cage’ (Tilson et al. 2010)—a scholarly debate is still ongoing whether the mechanisms of organizing underlying new meta-organizations are “bundles of old solutions” (Puranam et al. 2014) or fundamentally novel (Fjeldstad et al. 2012; Zammuto et al. 2007). Second, as expected with early-stage research on novel phenomena, a large proportion of empirical studies on meta-organization design and functioning is qualitative and based on case study research. Furthermore, many rigorous case studies of meta-organizations have been published over the last two decades. This current situation and state of progress of the literature invites a research approach that focuses on reanalyzing and synthesizing published studies, and in that process, reinterpreting case study data through the lens of a theoretical framework (Berente et al. 2019).

2. Theoretical Background

2.1. Post-Bureaucracy in the Networked Information Economy

In his work on how social production transforms markets and freedom, Yochai Benkler describes the emergence of the networked information economy: “What characterizes the networked information economy is that decentralized individual action—specifically, new and important cooperative and coordinate action carried out through radically distributed, nonmarket mechanisms that do not depend on proprietary strategies—plays a much greater role than it did, or could have, in the industrial information economy. The catalyst for this change is the happenstance of the fabrication technology of computation, and its ripple effects throughout the technologies of communication and storage. ... The material requirements for effective information production and communication are now owned by numbers of individuals several orders of magnitude larger than the number of owners of the basic means of information production and exchange a mere two decades ago” (Benkler 2006, p. 10). Today, we see that the “everyone’s IT” mindset, highlighting democratization of access to technology and individualization of technology use, is transforming traditional bureaucratic organizations (Gregory et al. 2018) while also driving the establishment of new forms of post-bureaucratic organizing including virtual, networked organizations (Ahuja and Carley 1999) and platform ecosystems (Wareham et al. 2014).

The term ‘post-bureaucracy’ started emerging in the early 1990s during times of widespread adoption and diffusion of digital technology, particularly the Internet and connected personal devices, which led to denser

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networks of communication and more distributed coordination spanning traditional organizational boundaries (Heckscher and Donnellon 1994). As explained by Michael Reed in his essay ‘Beyond the Iron Cage?’, post-bureaucracy scholars have predicted the “destructive impact of new information and communication technologies upon the central structural features and cultural supports of bureaucratic organization” (Reed 2005, p. 126). The post-bureaucracy discourse involves the argument that the traditional approach of organizing, including the division of labor into manageable jobs and tasks that individuals can be assigned to and held accountable for, as well as the integration of effort and work outcomes by senior leaders in the hierarchy, is no longer an effective approach to organizing in the networked information economy because this approach wastes the intelligence of individual workers and is not very susceptible to ongoing structural adaptation and change that is needed in contemporary organizations (Heckscher 1994).

The scholarly debate on the demise of bureaucracy and emerging characteristics of new post-bureaucratic forms of organizing continues until today, and there is some confusion over what elements of the old bureaucratic model (Weber 1946) are still present in new forms of organizing. Puranam and coauthors (Puranam et al. 2014) raise the provocative question ‘what’s new about new forms of organizing?’, highlighting in their brief review that most post-bureaucratic meta-organizations seem to adhere to some of the same basic principles of bureaucratic organizing, including some form of division of labor and some form of integration of effort.

What scholars of post-bureaucracy and new forms of organizing generally agree on is that the ‘iron cage’ is no longer the best metaphor to explain effective organizing in the networked information economy (Yoo et al. 2012). This old metaphor is associated with the hierarchy of power and formal managers that typically govern the division of labor and integration of effort inside large ‘Chandlerian’ organizations (Chandler 1962; Chandler 1977). Individual workers oftentimes feel ‘trapped in the iron cage’ as their autonomy is limited and managerial control is favored to achieve organizational goals and objectives (and sometimes personal interests of managers as well) (Mazmanian et al. 2013). The sociologist Yiannis Gabriel suggests that the image of a ‘glass palace’ is more suitable to explain effective ways of organizing in the more open, fluid, and pluralistic environments of today (Gabriel 2005). In line with this observation, recent research on IT consumerization highlights blurring boundaries between workers and consumers (Gregory et al. 2018), and consumers have become essential data producers that enable digital platform models (Gregory et al. 2020).

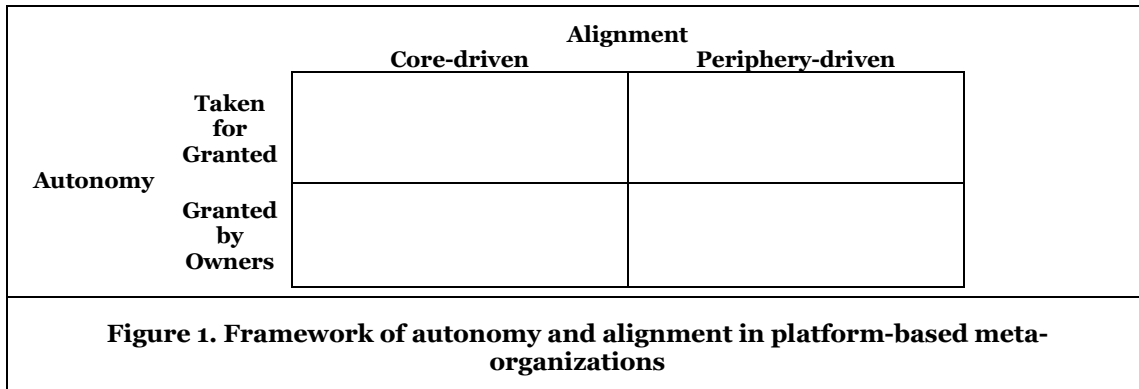
2.2. Platform-based Meta-organizations: Reconciling Autonomy and Alignment in the ‘Glass Palace’

The post-bureaucratic discourse summarized above provides the theoretical background for understanding the emergence of platform-based meta-organizations as a dominant form of organizing that relates to the fundamental shift from ‘iron cage’ to ‘glass palace.’ Meta-organizations can be viewed as a post-bureaucratic type as they leverage the unique properties and architecture of digital technologies (Yoo et al. 2010) for a new way of solving the problem of organizing (Puranam et al. 2014). They do so within distributed networks of autonomous actors without relying on formal contractual or managerial authority while ensuring alignment with system-level goals and objectives (Eaton et al. 2015; Gawer 2014; Gulati et al. 2012; Wareham et al. 2014).

The image of ‘glass palace’ (Gabriel 2005) fits well to describe the fundamental problem of organizing faced by designers of meta-organizations, including platform owners. On the one hand, the autonomy of individual workers, producers, or sellers is core to the functioning of meta-organizations with malleable and transparent ‘glass-like’ boundaries, because these individuals are distributed, work in loose commonality to others, and frequently are their own boss as free agents (Benkler 2006). On the other hand, meta-organizations have to solve the same fundamental problems of organizing as traditional organizations, including the division of labor and the integration of effort (Puranam et al. 2014), but without relying on traditional managerial control within the hierarchy of people as in traditional organizations. This implies that meta-organizations have to ensure alignment of individual-level activities with the system-wide goals and objectives of the ecosystem, in order to ensure the ‘palace’ does not break down.

Autonomy and Alignment in Platform-based Meta-organizations

A key question is how meta-organizations reconcile autonomy and alignment, i.e., through which mechanisms, and what, if any, is the role of digital technology for enabling these mechanisms? To guide the meta-analysis of studies on this topic, we introduce a high-level a-priori framework (see Figure 1).



The first dimension of the framework is *autonomy*, defined as the practical capacities of individual actors to create more value for and by themselves, and in loose commonality with others (Benkler 2006). We suggest that there are variations in how non-hierarchical meta-organizations deal with autonomy. On one end of the spectrum, autonomy may be *taken for granted* by the participating actors. To understand this manifestation of autonomy in meta-organizations, consider the concept of legitimacy, defined as “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, beliefs, and definitions” (Suchman 1995, p. 574). An important source of legitimacy of meta-organizations is their ability to convey effectiveness as a post-bureaucratic form, including their ability to leverage the intelligence of individuals as well as their ability for dynamic change and ongoing adaptation (Heckscher 1994). Autonomy is critical for people to fully contribute to defining and solving problems with their intelligence as well as launching and implementing organizational change initiatives (Katz 1965). Thus, it seems natural that autonomy is taken for granted as a generalized perception or assumption about meta-organizations as a post-bureaucratic form. The widespread diffusion of the “everyone’s IT” mindset, highlighting the democratization of access to technology and individualization of technology use (Gregory et al. 2018), adds further to the taken for grantedness of autonomy in meta-organizations as members expect to be empowered by digital technology and exercise their enhanced capacities.

On the other end of the spectrum, autonomy may be *granted by owners*. This is the case, for example, when a meta-organization sits at the interface between an open, free-market economy and a traditional organization that exhibits high levels of organizational control (e.g., Uber). When autonomy is granted by owners, with ‘owner’ referring to the platform or meta-organization owner as well as the managers representing the owner’s interests, this involves some form of conditional approval, defying any generalized assumption (Gulati et al. 2012). In this case, autonomy is granted to actors under the condition of strictly complying with rules and regulations stipulated by the platform-based meta-organization (Tiwana et al. 2010). The embeddedness of digital technology on platforms that serve as an infrastructure foundation for distributed organizing greatly facilitates the balancing act whereby autonomy is granted to actors while at the same time, some form of technology-enabled control is exercised that leads actors to perceive ‘the algorithm is my boss’ (Rosenblat and Stark 2016).

The second dimension of the framework is *alignment*, defined as the federation and coordination of constitutive actors distributed across the platform network to ensure optimal matching of supply and demand, desirable innovation, and/or behavioral congruence with the economic vision and cultural expectations set by the platform owner and its direct stakeholders (Gawer 2014). Alignment to achieve ecosystem-wide goals and objectives can be driven by the core or the periphery as the technological architecture of platform-based meta-organizations can be decomposed into a stable core maintained by the platform owner and peripheral modules contributed by the network of actors. When alignment follows a *core-driven* pattern, a central actor (which is often referred to as the platform owner, hub, or keystone organization) federates, coordinates, and orchestrates the network of actors to ensure congruence and

alignment with the meta-organization's overarching goals and objectives (Dhanaraj and Parkhe 2006; Gawer 2014; Gulati et al. 2012).

On the other hand, alignment that is *periphery-driven* is not achieved through the influence of the central actor, but peripheral actors themselves interact to derive a collective benefit from the participation on the platform-based meta-organization (Adner 2017; Jacobides et al. 2018). Because peripheral actors often have divergent interests and perspectives, the multilateral relationships between these actors need to be aligned such that all actors agree on their positions and flows in relation to each other and adapt their behavior accordingly to achieve collective benefits (Adner 2017).

3. Method: Qualitative Meta-analysis

In order to identify mechanisms that achieve autonomy and alignment in meta-organizations, we employed a qualitative meta-analysis (cf. Noblit and Hare 1988) of 16 case studies similar to Berente et al. (2019). A qualitative meta-analysis is adequate in this area of interest, as a large proportion of empirical studies on meta-organization design and functioning is based on case study research.

The dual goal of qualitative meta-analysis is (1) to translate constructs from different case studies into each other by reinterpreting existing case studies beyond the original authors interpretations (in contrast to methods that merely aggregate findings such as systematic literature reviews or quantitative meta-analyses); and (2) to articulate theoretically generalizable findings attentive to the context of each individual case study (Berente et al. 2019; Combs et al. 2019; Habersang et al. 2019; Hoon 2013; Noblit and Hare 1988). While single case studies provide rich and contextualized descriptions of single settings, qualitative meta-analysis seeks to uncover generalizable constructs among multiple case study settings (Habersang et al. 2019). The constructs uncovered through comparison of multiple cases are not necessarily the same as the constructs that the original authors used (Berente et al. 2019). However, to make constructs comparable across cases it is necessary to standardize construct operationalization (e.g., via a coding scheme) (Berente et al. 2019).

The application and description of the qualitative meta-analysis in this paper is guided by the recommendations of Noblit and Hare (1988) and Berente et al. (2019). Thus, we first describe the sampling of relevant case studies and proceed with an outline for the coding procedure applied to the case studies.

3.1. Sampling

We adopted a purposeful sampling strategy (Noblit and Hare 1988) to identify publications that fit our research question. We started our sampling procedure with the development of a string of keywords that contained synonyms for platform and ecosystem¹. We chose the leading information systems journals in the Senior Scholars' Basket of Eight Journals of the Association for Information Systems as the literature sources and applied the keyword string to the database Scopus. The literature search yielded 354 publications that we carefully screened regarding their titles and abstracts (resulting in 78 articles) and full texts (resulting in 26 articles) using our predefined criteria for inclusion and exclusion. To be included in our sample, publications had to adopt a qualitative method with detailed case write-ups. In addition, we only included publications whose case organizations resemble characteristics of digital platform meta-organizations. Conversely, we excluded conceptual, prescriptive, and empirical papers relying on quantitative methods similar to Berente et al. (2019). We subsequently conducted a backward search on the resulting 26 articles which added four additional articles to our final sample of 30 case study publications. We limited our analysis to 16 papers from our final sample to gain a representative yet manageable set of papers for this research in progress paper and will extend the analysis to the remaining cases in our future development of the paper. The case studies we analyzed were distributed among several case contexts including enterprise software, operating systems, crowdfunding, crowdsourcing, healthcare, and e-commerce and both innovation platforms and transaction platforms (Cusumano et al. 2019) were present.

¹ The specific keywords were based on, e.g., de Reuver et al. (2018) or Nischak et al. (2017), and were: platform*, "multi-sid*", multisid*, "two-sid*", twosid*, ecosystem*, "ecosystem*", or "eco system*" for the title, abstract, and keyword section of the papers.

3.2. Coding

After sampling the case studies, the qualitative meta-analytic technique proceeds with determining how the studies are related. Because the qualitative meta-analysis depends on the researchers understanding and interpretation of the case material, we adopted a rigorous and iterative coding procedure to “standardize” the interpretations similar to Berente et al. (2019).

For the interpretation of the case studies, we adopted a semi-open coding procedure that contained three iterative steps. In the first step, we developed an initial coding scheme based on our a-priori framework. The initial coding scheme contained two categories. The first set of codes identified the dimensions of *autonomy* that are present in the meta-organization. Since autonomy is rather high in meta-organizations, we looked for situations in which autonomy is *granted by owners* of platform meta-organizations. Conversely, when autonomy is not explicitly granted, we coded autonomy as being *taken for granted* in the respective meta-organization. The second set of codes in the coding scheme recognized the dimensions for *alignment* that are prevalent in the meta-organization. We coded alignment that is initiated by the owner of the meta-organization at the platform core as *core-driven*. In contrast, *periphery-driven* alignment was identified when alignment emerges through interaction among the meta-organization actors.

In the second step, one of the authors coded the cases based on the initial coding scheme and developed write-ups for each case. Throughout the coding procedure, the initial coding scheme was extended by organizational mechanisms that achieve autonomy and alignment and the properties and architecture of digital technologies that enable these organizational mechanisms. Mechanisms were identified and coded based on the successful reconciliation of autonomy and alignment (see definitions provided before). The coding and case write-ups resulted in a case-ordered matrix where each row covered the case context, the dimension of autonomy (i.e., taken for granted or granted by owner), the dimension of alignment (i.e., core-driven or periphery-driven), and the identified mechanisms (see Tables 1-4 for examples).

In the third step, all authors discussed the results and challenges of the coding and jointly classified the identified mechanisms in the quadrants of the framework. The iterative coding and theoretical development stopped when we achieved a reliable and valid treatment of the constructs across the cases.

4. Findings

In this section we describe the findings of the qualitative meta-analysis of 16 case studies. We identified eight mechanisms throughout the analysis that we classified in the quadrants of our theoretical framework. The framework with the classified mechanisms is illustrated in Figure 2.

		Alignment	
		Core-driven	Periphery-driven
Autonomy	Taken for Granted	Values Promoted by the Platform Owner Standards for Participation Standardized Access to Knowledge for Participation	Social Feedback Free-market Matching
	Granted by Owners	Standards for Constrained Participation Guided Access to Knowledge for Participation	Guided Matching

Figure 2. Framework of autonomy and alignment in platform-based meta-organizations with mechanisms

The findings are reported in four subsections that follow the quadrants of our theoretical framework. We describe the identified organizational mechanisms and the properties and architecture of digital technologies that enable these organizational mechanisms.

4.1. Taken for Granted Autonomy & Core-driven Alignment

We identified nine cases of digital platform meta-organizations where autonomy was taken for granted and alignment was core-driven. Table 1 gives an overview of the supporting cases, including evidence for taken for granted autonomy and core-driven alignment along with the identified mechanisms in the case studies.

Table 1: Taken for Granted Autonomy/Core-driven Alignment

Source	Context	Taken for Granted Autonomy	Core-driven Alignment	Mechanism
Eaton et al. (2015)	Innovation platform (Apple iOS)	Heterogenous actors have considerable autonomy to decide whether to resist or accommodate the decisions of the platform owner.	The platform owner (Apple) forced other actors (e.g., complementors) to comply to their goals. “Adobe, is forced to accommodate the plug-in and, by implication, Apple’s goals.” (p. 228)	Standards for participation “Many, such as Condé Nast and Hearst, adopt Apple’s in-app subscription mechanism.... Others, such as Financial Times, decide to accommodate and change their goals and to capitalize on the generativity of iOS. They do so by removing their content, apps and installed base from the App Store and distributing them as HTML5 web apps, thereby bypassing Apple’s subscription mechanism and the associated rules....” (p. 234)
Foerderer et al. (2019)	Innovation platform (enterprise software industry)	Complementors had taken for granted autonomy because they did not necessarily had to directly interact with the platform owner to obtain knowledge about the platform.	“Complementors were dependent on platform owners to access knowledge of the platform’s functionality.” (p. 131)	Standardized access to knowledge for participation “On [the platform], for example, [the platform owner] relied on the “learning hub,” an information portal publishing publicly available development-related information that was available 24/7.” (p. 130) “Documentation is the most valuable resource for developers.... They learn the technologies by searching for the needed information.” (p. 136)
Ghazawneh and Henfridsson (2013)	Innovation platform (Apple iOS)	The platform owner (Apple) initially designed the platform open and accessible for all actors (e.g., complementors or end users). “We want native third party applications on the iPhone, and we plan to have an SDK in developers’ hands.” (p. 182)	The platform owner (Apple) defined and managed the interface to complementors.	Standards for participation “Most boundary resources are optional in the application development and their use depends on the third-party developers’ design choices in seeking to serve their customers, the end-users.” (p. 177)

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Huber et al. (2017)	Innovation platform (enterprise software industry)	Values were taken for granted by all actors and actors were able to autonomously refer to these values. “Timeliness, reliability, trustworthiness.... It’s about all these mundane matters that should be taken for granted for someone who is somewhat good-mannered.” (p. 572)	“Values are actively and deliberately instilled by platform owners.” (p. 564)	Values promoted by the platform owner “Ultimately, it should be a win-win situation—[platform owner] and [complementor] should be successful.... And that is what my communication with partners is based on—sincerity, trust, and regular exchange [values]....” (p. 572)
Karhu et al. (2018)	Innovation platform (Google Android)	Competitors were autonomously able to hack (“fork”) the Android platform.	Code forks challenged the cooperation between the platform owner (Google) and complementors. “Our partner was notified by Google that if the product runs Aliyun OS, Google will terminate its Android-related cooperation and other technology licensing with our partner.” (p. 487)	Standards for participation “To foster cooperation with the complementors, the platform owner can use an open-source license boundary resource to open its core platform resources.” (p. 479) “The host can actively use boundary resources to defend against platform forks.” (p. 490)
Kazan et al. (2018)	Innovation platforms/ transaction platforms (Blockchain.info, Paym, Zapp)	Complementors (e.g., developers) had taken for granted autonomy because the platform was “highly open and accessible to external developers” (p. 204) and complementors were able to integrate with the platform without the need for permission.	The platform owner (e.g., Blockchain.info) provided open access to its platform to “co-innovate with external developers.” (p. 209)	Standards for participation “Blockchain.info’s APIs are documented and publicly available without restriction: “Our APIs are basically gateways to interface with any type of protocol, so we are highly compatible, we are entirely open, there are no walled gardens.” (p. 204)
Qiu et al. (2017)	Innovation platform (Apple iOS)	The autonomy of complementors (i.e., independent developers) was taken for granted and they had considerable agency.	“Apple’s tradition of appreciation for design and quality concurrently influences developers’ decisions.” (p. 238)	Values promoted by the platform owner “Apple ... recognizes well-designed software with their annual design awards. Developers also look up to Apple products for design inspiration.” (p. 238) “Developers refer to the strong emphasis of the platform owner on quality products, design aesthetics, etc. as the “Apple philosophy.” (p. 246)

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Rolland et al. (2018)	Innovation platform (news industry)	Initially, “decentralized regimes facilitated local innovation by developing and realizing options to extend the platform’s core features.” (p. 441) “The platform was extremely configurable for end users, and journalists had over the years made countless adjustments to the standard configuration.” (p. 432)	For the complementor it was beneficial to align with the goals of the platform owner. “Collaborating with other platform users and Platform Company, new options were identified for improving newsroom work processes and potentially resolving accumulated digital debt.” (p. 434)	Standards for participation “The digital platform afforded access to standardized interfaces and protocols that provided new digital options for exchanging multi-media content across different platforms and systems in the digital infrastructure.” (p. 427)
Selander et al. (2013)	Innovation platform (Sony Ericsson)	Actors (e.g., complementors) had taken for granted autonomy to actively search for capabilities and resources outside their affiliated ecosystem and were not dependent on one specific platform.	It was beneficial for actors to align to the goals of the platform and be interoperable. “They established a formal partnership to redeem capability from this ecosystem and decided to ship their new product line with the Crossfire run-time software engine.” (p. 190)	Standards for participation “Under the terms of the agreement, Borland plans to distribute and support the Sony Ericsson Java Software Development Kit (SDK) through the Borlands JBuilder 9 Mobile Edition, accelerating the application development lifecycle for wireless Java-based devices.” (p. 191)

We identified three key mechanisms through our analysis of the nine case studies: *values promoted by the platform owner*, *standards for participation*, and *standardized access to knowledge for participation*. The three mechanisms are discussed in the following three subsections.

4.1.1. Values Promoted by the Platform Owner

Values promoted by the platform owner and shaped by the technological trajectory of the platform provide a mechanism to achieve taken for granted autonomy and core-driven alignment at the same time. Owners of digital platform meta-organizations establish key goals, principles, norms, and common values to empower collaboration and alignment among actors. These values are communicated core-driven from the platform owner to the surrounding actors. Because these values apply equally to all actors they are commonly perceived as being taken for granted.

Huber et al. (2017) provide an illustrative example from the enterprise software platform context for how platform owners can emphasize or favor values to empower autonomous actors. They describe how partnership managers from the platform owner organization are guided by ecosystem-wide values (e.g., the principle of equality) when making decisions regarding complementors. One partnership manager described this interaction with complementors as follows:

“Ultimately, it should be a win–win situation—[platform owner] and [complementor] should be successful.... And that is what my communication with partners is based on—sincerity, trust, and regular exchange [values]....” (Huber et al. 2017, p. 572)

Thus, the platform owner made a commitment to complementors to ensure fair cooperation where all partners are treated equally (Huber et al. 2017). Platform owners are often supported by the technological trajectory of the platform itself in defining and emphasizing values as the case by Qiu et al. (2017) in the mobile operating platform context illustrates. They show, that past design decisions of the platform owner Apple (e.g., focus on high quality and performance) shaped the platform’s long-term philosophy or culture and provided inspiration for complementors when developing their apps. Apple’s emphasis on aesthetics and form of their products, an appreciation for polished design, and a focus on user experience and product quality aligned autonomous complementors around the so called “Apple philosophy” (Qiu et al. 2017).

4.1.2. Standards for Participation

Standards set by the platform owner such as boundary resources have the ability to achieve taken for granted autonomy and core-driven alignment at the same time. Platform owners design standards for participation to ensure that complementors align with their goals and interests. These standards are typically provided by the platform owner as boundary resources (e.g., application programming interfaces (APIs) or software development kits (SDKs)) that standardize the interface between the platform and complements (Ghazawneh and Henfridsson 2013). Boundary resources can be used to increase the scope and diversity of possibilities on the platform, which is called “resourcing” (Ghazawneh and Henfridsson 2013). Resourcing enables opening access to resources of the platform or making the whole platform core “open source” (Rolland et al. 2018).

Standardized interfaces in the form of boundary resources also help to achieve the benefits of modularity by increasing the decoupling of digital platforms such that the behavior of the platform owner at the platform core is loosely coupled from the behavior of complementors that develop complements located on the periphery (Tiwana et al. 2010). Therefore boundary resources provided by the platform owner enable complementors to autonomously decide whether to accommodate or resist to use them (Eaton et al. 2015). When they resist, they can self-resource boundary resources by developing new boundary resources according to their local needs as a response to limitations in the boundary resources provided by the platform owner (Eaton et al. 2015; Ghazawneh and Henfridsson 2013). Eaton et al. (2015) illustrate the accommodation and resistance of boundary resources both from platform owners and complementors in the context of Apple’s iOS operating system platform. They describe how some complementors autonomously decided to accommodate boundary resources such as the in-app subscription mechanism provided by the platform owner Apple to participate on the platform while others resisted to use it but instead developed their own boundary resources:

“Many, such as Condé Nast and Hearst, adopt Apple’s in-app subscription mechanism.... Others, such as Financial Times, decide to accommodate and change their goals and to capitalize on the generativity of iOS. They do so by removing their content, apps and installed base from the App Store and distributing them as HTML5 web apps, thereby bypassing Apple’s subscription mechanism and the associated rules....” (p. 234)

Other cases in which boundary resources facilitated access to the platform include a news organization (i.e., a complementor) that adopted a digital platform for their newsroom (Rolland et al. 2018). Rolland et al. (2018) found that boundary resources enabled the complementor (Media Company) to develop new digital options to improve and customize newsroom work processes:

“Media Company identified, developed, and realized several options related to its implementation of News Platform. Importantly, this investment provided Media Company with APIs to develop customized apps and modules, and with direct access to important new competencies in Platform Company.” (p. 433)

We can infer from these cases that boundary resources provide a mechanism to align the goals and interests of the platform owner, who designs boundary resources, and complementors who autonomously decide whether to accommodate or resist the use of these boundary resources.

4.1.3. Standardized Access to Knowledge for Participation

Taken for granted autonomy and core-driven alignment can also be achieved when digital platform meta-organizations provide standardized access to knowledge for participation on the platform in the form of broadcasting knowledge boundary resources. To participate on digital platforms and to be aligned with the platform’s goals, complementors need standardized and unconditional access to knowledge pertaining to the digital platform’s core functionality and boundary resources that resides within the platform owner (Foerderer et al. 2019). Complementors need to overcome this knowledge boundary to access and extend the platform’s core functionality by developing complements (e.g., apps) (Foerderer et al. 2019).

Platform owners provide broadcasting boundary resources (e.g., information portals or technical documentation) as a means to overcome knowledge boundaries to retain the individual autonomy of

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complementors while aligning them to their own interests and goals (Foerderer et al. 2019). The case study of Foerderer et al. (2019) provides evidence for broadcasting boundary resources that provide knowledge in the form of standardized and transferable resources often centrally stored on the platform. These resources can be accessed by complementors with minimal interaction with the platform owner (Foerderer et al. 2019). The platform owner in the case study stated the significance of broadcasting knowledge boundary resources as follows:

“Documentation is the most valuable resource for developers.... They learn the technologies by searching for the needed information.” (p. 136)

Documentation along with other development-related information was provided by the platform owner in form of an information portal called the “learning hub” where complementors could autonomously search and access information and resources:

“On [the platform], for example, [the platform owner] relied on the “learning hub,” an information portal publishing publicly available development-related information that was available 24/7.” (p. 130)

Because the broadcasting knowledge boundary resources provide a standardized access for complementors to obtain knowledge for participation on the platform, broadcasting boundary resources can be scaled to high numbers of complementors (Foerderer et al. 2019).

4.2. Granted by Owner Autonomy & Core-driven Alignment

From our sample, six cases involved autonomy granted by owners and core-driven alignment. These six cases are illustrated in Table 2 along with the identified mechanisms.

Table 2: Granted by Owner Autonomy/Core-driven Alignment

Source	Context	Granted by Owner Autonomy	Core-driven Alignment	Mechanism
Foerderer et al. (2019)	Innovation platform (enterprise software industry)	The platform owner granted a higher level of autonomy to selected complementors.	“Complementors were dependent on platform owners to access knowledge of the platform’s functionality.” (p. 131)	Guided access to knowledge for participation “[Platform owner] provided selected complementors with an 18 to 24-month roadmap on planned changes to the platform.” (p. 137)
Ghazawneh and Henfridsson (2013)	Innovation platform (Apple iOS)	Over time, the platform owner Apple granted considerable autonomy only to those complementors who followed the interests of the platform owner.	The platform owner (Apple) defined and managed the interface to complementors.	Standards for constrained participation “Applications may only use Documented APIs in the manner prescribed by Apple and must not use or call any private APIs. Applications must be originally written in Objective-C, C, C++, or JavaScript as executed by the iPhone OS WebKit engine, and only code written in C, C++, and Objective-C may compile and directly link against the Documented APIs.” (p. 185)
Huber et al. (2017)	Innovation platform (enterprise software industry)	The platform granted exclusive access to nonstandard platform resources for selected complementors by going beyond ecosystem-wide rules. “Yes, I make exceptions to the rule..., but there is no exclusivity principle. The partner is an independent company and so are we.” (p. 573)	The platform owner defined rules that regulated the rights and duties of complementors.	Standards for constrained participation “Some partnerships generated additional co-creation opportunities and received increasing attention from the platform owners. In these partnerships, governance developed into closer, more alliance-like collaborations that went beyond ecosystem-wide rules.” (p. 564)

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Kazan et al. (2018)	Innovation platforms/ transaction platforms (Circle, Droplet, Pingit)	Only granted, selected, and authorized complementors were able to participate on the platforms.	“Pingit is ... in a comfortable position to dictate its collaborative relationships with external parties, who desire to develop approved platform derivatives for the mobile payment service.” (p. 197)	Standards for constrained participation “Through supplying boundary resources (i.e., approved developmental tools) as part of its value creation architecture, Droplet encourages external developers to generate their own platform derivatives with customized business rules to meet the ongoing needs of the market.” (p. 199)
Moehlmann et al. (2020)	Transaction platform (Uber)	While the actors on the Uber platform (e.g., drivers and riders) perceived that they are “the boss”, their autonomy was limited by the algorithm deployed by the platform.	The platform owner actively influenced actors (e.g., Uber drivers) to ensure their alignment with the platform’s meta-organizational goals and KPIs.	Standards for constrained participation “There were a couple of these rules for logic. There should be rules that we program into the app. For instance, if you don’t accept three trips in a row, the app will just switch off for 15 minutes or whatever.” (p. 18)
Wareham et al. (2014)	Innovation platform (enterprise software industry)	“Partners [i.e., complementors] are granted very high levels of autonomy when they enter the ecosystem.” (p. 1203)	The platform owner approved and validated complementors that wanted to participate on the platform.	Standards for constrained participation “There are no barriers to becoming a platform partner if you comply with their certification requirements.” (p. 1208) “Application certification and catalogues enable complements on the periphery to pursue individual benefits (actor autonomy); certified complements are thereafter publicised and reused by the ecosystem (collective identifications).” (p. 1211)

Two mechanisms were identified through the analysis of the six cases. These mechanisms involved *standards for constrained participation* and *guided access to knowledge for participation* that are described in the following two subsections.

4.2.1. Standards for Constrained Participation

Standards such as boundary resources (e.g., rules and regulations) are also used to constrain participation because the platform owner can grant autonomy to actors and facilitate core-driven alignment. Boundary resources serve the purpose to preserve the platform owner’s influence over the platform, which is called “securing” (Ghazawneh and Henfridsson 2013). Securing involves processes enacted by platform owners that ensure the compliance of rules by complementors.

For example, in the case study carried out by Ghazawneh and Henfridsson (2013) the platform owner Apple formulated a developer license agreement that stated how complementors can and should behave according to the rules formulated by Apple:

“Applications may only use Documented APIs in the manner prescribed by Apple and must not use or call any private APIs. Applications must be originally written in Objective-C, C, C++, or JavaScript as executed by the iPhone OS WebKit engine, and only code written in C, C++, and Objective-C may compile and directly link against the Documented APIs.” (p. 185)

Securing and constraining access through boundary resources enables platform owners to grant more autonomy to complementors that adhere to the platform owner’s goals and interests while facilitating core-driven alignment.

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Platform owners define, but have the ability to situationally depart from formal rules such as certification levels to grant autonomy to actors while enabling core-driven alignment. Through formal rules (e.g., certification levels such as gold partnership), platform owners facilitate congruence of interests with other actors and make sure that these actors comply with the defined rules and regulations. Actors that comply with the rules and regulations are granted more autonomy through conditional approval by the platform owner.

The case studies by Wareham et al. (2014) and Huber et al. (2017) in the enterprise software platform context provide evidence for the application of formal rules through certification. In both cases the platform owner granted autonomy to complementors according to their level of certification. In these cases, each level of certification entailed access to specific platform resources (e.g., gold level complementors gain access to more/advanced resources than silver level complementors). They show that when complementors wanted to access platform resources, the platform owner approved and validated them based on the specific level of certification. The significance of certification has been emphasized by one complementor as follows:

“There are no barriers to becoming a platform partner if you comply with their certification requirements.” (Wareham et al. 2014, p. 1208)

However, in situations in which the platform owner and complementors had the potential for increased co-creation, the platform owner had the ability to go beyond the defined rules and grant more autonomy to actors (Huber et al. 2017). For example, Huber et al. (2017) illustrate how partnership managers appointed by the platform owner granted complementors, that had high co-creation potential, access to nonstandard platform resources beyond their level of certification. One partnership manager of the platform owner organization noted:

“Yes, I make exceptions to the rule..., but there is no exclusivity principle. The partner is an independent company and so are we.” (p. 573)

Going beyond rules and certification levels thus grants selected complementors more autonomy while developing stronger alignment through closer relationships between the platform owner and complementors (Huber et al. 2017).

The case study by Moehlmann et al. (2020) with the Uber platform demonstrates how rules and standardized processes are built into algorithms by the platform owner to actively influence drivers' behavior. One Uber employee described how rules and algorithms contingently influence drivers:

“There were a couple of these rules for logic. There should be rules that we program into the app. For instance, if you don't accept three trips in a row, the app will just switch off for 15 minutes or whatever.” (p. 18)

We can observe in this case that drivers that comply with the rules implemented in the algorithm are granted more autonomy while staying aligned with the platform owner.

4.2.2. Guided Access to Knowledge for Participation

Digital platform meta-organizations reconcile autonomy granted by the platform owner and core-driven alignment when platform owners provide guided access to knowledge for participation on the platform in the form of brokering and bridging knowledge boundary resources. Platform owners can provide selected complementors guided and conditional access to knowledge regarding the digital platform so that these complementors can develop complements that are aligned with the platform owner's interests and goals (Foerderer et al. 2019).

Platform owners draw on brokering (e.g., helpdesks or account managers) and bridging (e.g., one-to-one assistance or alignment workshops) knowledge boundary resources to grant selected complementors guided access to knowledge while aligning interests and goals (Foerderer et al. 2019). The case by Foerderer et al. (2019) illustrates the application of brokering and bridging knowledge boundary resources in the enterprise software platform context. In their case study, platform owners intensively exchanged knowledge with individual complementors. The application of brokering and bridging knowledge boundary resources can be illustrated as follows:

“[Platform owner] provided selected complementors with an 18 to 24-month roadmap on planned changes to the platform.” (p. 19)

Because the knowledge exchange between platform owners and complementors is intense and frequent (often one-to-one) and the support of digital technology is limited, the scalability of brokering and bridging knowledge boundary resources is also limited, and these knowledge boundary resources can be granted only to selected complementors. These selected complementors can be strongly aligned to the platform because their individual knowledge needs can be satisfied.

4.3. Granted by Owner Autonomy & Periphery-driven Alignment

Two cases from our sample were characteristic of digital platform meta-organizations exhibiting autonomy granted by owners and periphery-driven alignment. An overview over these cases is given in Table 3.

Table 3: Granted by Owner Autonomy/Periphery-driven Alignment

Source	Context	Granted by Owner Autonomy	Periphery-driven Alignment	Mechanism
Leong et al. (2019)	Transaction platform (Damai)	The platform owner granted autonomy to actors that complied with the platform owner’s goals and interests.	Multiple platform actors aligned and collaborated freely with each other. “This function of “yiqipin” (which means “fight together” in Chinese) allows customers to buy tickets together [for a discount] and to share accommodations and transportation if they must travel to another city for the performance.... Put simply, we allow the customers to make requests to other customers.” (p. 1543)	Guided Matching The platform had the ability of “manipulating relationships among the different groups of actors using technologies” (p. 1542). For example, “empowering a group of actors through allowing them direct access to other actors or to areas or processes previously under the complete control of another actor” (p. 1542) or “one actor being granted greater control or influence over one relationship or another” (p. 1546).
Moehlmann et al. (2020)	Transaction platform (Uber)	While the actors on the Uber platform (i.e., drivers and riders) perceived that they are “their own boss”, their autonomy was limited by the algorithm deployed by the platform. In that sense the algorithm grants the autonomy.	Platform actors interacted with each other and shared experiences with each other. For example, the positioning of the individual driver on the map is not determined by a work plan but by individual choices.	Guided Matching “When we think about how matches actually happen between riders and drivers, then this happens algorithmically, and what we are solving is for riders and drivers in aggregate to get the best possible matches for the marketplace.” (p. 16)

We identified the mechanism *guided matching* through the analysis of these two case studies that we describe in the following subsection.

4.3.1. Guided Matching

Digital platforms reconcile autonomy granted by the platform owner and periphery-driven alignment through the mechanism of guided matching that is supported by digital technology and in particular algorithms. This mechanism leverages that the digital platform is in the middle of each transaction, which enables the platform owner to collect and analyze data to nudge and guide the autonomous decision making of the actors. Digital platforms support actors forming relationships with other actors by facilitating matches of the platform actors on (different) platform sides that are favorable to achieve ecosystem-wide goals (e.g., through algorithmic data analysis or technology). Such guided matching ensures that participants on (different) platform sides are aligned and mutually benefit from each other. On the other

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hand, the platform only guides actors in making their autonomous decision on whether and when to enter relationships on the platform with other actors.

The case study with the Uber platform carried out by Moehlmann et al. (2020) provides evidence for matching facilitated through algorithmic data analysis. For example, one Uber executive explained the significance of algorithms when matching riders and drivers on their platform:

“When we think about how matches actually happen between riders and drivers, then this happens algorithmically, and what we are solving is for riders and drivers in aggregate to get the best possible matches for the marketplace.” (p. 16)

However, matches suggested by the platform only function as a guidance for drivers because “riders and drivers make transactions” and management only ensures that “information is available for both sides to facilitate decision making” as one Uber executive noted in the case study (Moehlmann et al. 2020, p. 17).

With algorithmic matching through algorithms and technology, platforms can explore and influence relationships between actors (Leong et al. 2019). Platforms are flexibly “manipulating relationships among the different groups of actors using technologies” and “empowering a group of actors through allowing them direct access to other actors or to areas or processes previously under the complete control of another actor” (Leong et al. 2019, p. 1542).

4.4. Taken for Granted Autonomy & Periphery-driven Alignment

Another six cases involved taken for granted autonomy and periphery-driven alignment. An overview over these cases and identified mechanisms is given in Table 4.

Table 4: Taken for Granted Autonomy/Periphery-driven Alignment

Source	Context	Taken for Granted Autonomy	Periphery-driven Alignment	Mechanism
Alaimo et al. (2020)	Transaction platform (TripAdvisor)	Different actors (e.g., internet booking engines, partner platforms, end users, etc.) had taken for granted autonomy and strong positions in the ecosystem.	It was important for the ecosystem formation that multiple actors aligned with each other and shared data to form so called “data relations.”	Social Feedback “The shift from the use of traditional and already available travel data sources (hotel, destination and product data) to a new and until then largely unknown data type, produced by large user crowds contributing their reviews, ratings and networking data to the platform amass.” (p. 42)
Barrett et al. (2016)	Transaction platform (online health community)	New members of the online health community were able to select the disease groups that they wanted to join and to customize the platform according to their needs.	Members of the online health community voluntarily interacted with each other by sharing stories and experiences about coping with certain diseases.	Social Feedback Members of the online health community “both attempted to give support (“sorry to hear you are feeling so low”) and to acknowledge when they had received it (“it was so nice for me to read about you and to feel that I am not alone”)” (p. 712).
Bergvall-Kåreborn and Howcroft (2014)	Innovation platforms (Apple iOS & Google Android)	Individual developers had considerable autonomy.	Alignment between developers and end users was seen as mutually beneficial. “Building informal networks also becomes increasingly important for occupational advice and support.” (p. 436)	Social Feedback “I think the only way is to listen to the feedback and really try to deliver exactly what the user wants.” (p. 435)

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Moehlmann et al. (2020)	Transaction platform (Uber)	Actors (e.g., drivers or riders) on the Uber platform had taken for granted autonomy over socialization activities.	Platform actors interacted and shared experiences with each other in the absence of influence from the core. “These communities are not facilitated by Uber, but are created and maintained by the drivers themselves, beyond Uber’s control.” (p. 40)	Social Feedback “A lot of people get together in the same WhatsApp group and they try to understand better how to make money on the platform...Trying to understand and trying to improve upon the work.” (p. 32)
Qiu et al. (2017)	Innovation platform (Apple iOS)	The autonomy of complementors (i.e., independent developers) was taken for granted and they had considerable agency.	Complementors interacted and influenced each other and also communicated directly with end users. “Mac indie developers have influenced new iOS developers with their values and beliefs through socialization activities that occur online and offline.” (p. 237)	Social Feedback One independent developer noted “feedback is the key” (p. 242).
Taylor and Joshi (2019)	Transaction platforms (Elance, oDesk, Rent-a-coder)	Workers had the opportunity to autonomously choose jobs and operate without oversight from others (e.g., they can choose when, where, and how to work).	Managing relationships with other workers and/or customers was an important skill for workers.	Free-market Matching “I can try out a few different employers and see which one I am more compatible with.” (p. 654)

Two mechanisms were salient among the six case studies: *social feedback* and *free-market matching*. We describe these two mechanisms in the following two subsections.

4.4.1. Social Feedback

Platform-based meta-organizations achieve taken for granted autonomy and periphery-driven alignment through social feedback supported by technological mechanisms that enable support, feedback, rating, and communication among platform actors. Communities for social feedback are often formed autonomously by platform meta-organization actors outside the platform owner’s influence. Actors provide each other support and feedback to align with each other. Social feedback is often implemented on the platform through mechanisms such as forums, feedback, or communication technology provided by the platform owner or created by actors outside the platform. These mechanisms are often nurtured by the actors itself without influence from the platform owner.

The case study by Moehlmann et al. (2020) illustrates social feedback on the Uber platform. They found that although drivers on the Uber platform enjoyed their autonomy of being their own boss, they also liked being part of a community of drivers. Some drivers initiated communities (e.g., an online forum called ‘Uberpeople.net’, social media groups on WhatsApp, or informal offline conversations) to share personal stories or provide mutual support with other drivers (Moehlmann et al. 2020). One driver in the case study stated the benefits of social feedback as follows:

“A lot of people get together in the same WhatsApp group and they try to understand better how to make money on the platform...Trying to understand and trying to improve upon the work.” (p. 32)

Interestingly, the platform owner Uber did not play an active role in building and nurturing the community of drivers.

Another case in point is the Mac indie developer community that was present in the study carried out by Qiu et al. (2017). Mac indie developers influenced new iOS developers through socialization. For example, they shared and provided peer recognition, status, and feedback to iOS developers and strongly affected

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how new iOS apps were developed. One developer in the case study emphasized “feedback is the key” (p. 242). Gaining support by peers was enabled through feedback and reputation mechanisms implemented by the platform.

The mechanism social feedback is often facilitated by the platform itself but is built and nurtured autonomously by the actors themselves and stays out of direct influence of the platform owner. It enables that actors provide feedback to each other for alignment.

4.4.2. Free-market Matching

Another mechanism that reconciles taken for granted autonomy and periphery-driven alignment is free-market matching enabled through technological platform mechanisms. Platform actors have considerable autonomy to self-select and match themselves to other actors without being forced, supervised, or guided by the platform owner. Actors match and align their different skillsets and preferences with each other to achieve congruence of their goals and interests. Actors harness technological features of the platform to match themselves with other actors.

The case study by Taylor and Joshi (2019) provides an instance for free-market matching in the context of online labor platforms. In their study, workers on the online labor platform can self-select the jobs they want to accomplish based on their skills, availability, and interests. A worker from the studied platform explains this matching from her perspective:

“I can try out a few different employers and see which one I am more compatible with.” (p. 654)

Free-market matching is enabled by the bidding mechanism on the online labor platform that allows workers to bid on the type of tasks that best fits their skills, availability, and interests at a given time (Taylor and Joshi 2019).

We can infer from this case, that actors retain their autonomy through free-market matching and align their skills and preferences with the goals of other actors without direct influence from the platform owner.

5. Expected Contributions (Research in Progress)

In this paper we described eight key mechanisms enabled by digital technology for synthesizing autonomy and alignment in platform-based meta-organizations as a new form of organizing. Based on a systematic qualitative meta-analysis of empirical studies, the identified mechanisms were classified into an a-priori derived framework consisting of two dimensions: (1) autonomy that can be taken for granted or granted by the owner of the platform-based meta-organization; and (2) alignment that can be core-driven or periphery-driven. In sum, we provide an integrated framework with organizational mechanisms supported by digital technology that reconcile autonomy and alignment in platform-based meta-organizations. We expect to contribute to the literatures on (1) new forms of organizing (Fjeldstad et al. 2012; Puranam et al. 2014; Zammuto et al. 2007), and (2) platform-based meta-organizations (Gawer 2014; Gulati et al. 2012).

First, we expect to contribute to the literature on new forms of organizing by connecting previous discussions about whether the mechanisms of organizing underlying new meta-organizations are “bundles of old solutions” (Puranam et al. 2014) or fundamentally novel (Fjeldstad et al. 2012; Zammuto et al. 2007). Some studies based their analysis of mechanisms on the assumption that the fundamental problem of organizing between the division of labor into manageable jobs and tasks that individuals can be assigned to and held accountable for, as well as the integration of effort and work outcomes by senior leaders in the hierarchy, has to be solved (Puranam et al. 2014). We argue that the traditional approach of organizing is no longer an effective approach to organizing because meta-organizations as a new form of organizing in the networked information economy assume high levels of autonomy and ecosystem-wide alignment at the same time (Benkler 2006; Gawer 2014; Gulati et al. 2012). Based on these two dimensions of autonomy and alignment that resemble the assumptions of platform-based meta-organizations, we derived a theoretical framework. The dimension autonomy is considered in the framework as being taken for granted or granted by the owner of the platform meta-organization whereas the dimension alignment is considered as being core-driven or periphery-driven. Based on the qualitative meta-analysis of 16 studies we observed that the traditional mechanisms identified in previous studies are either fundamentally altered by digital

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technology or completely new mechanisms emerge. For example, standards were previously used to control actors while digital technology gives rise to standards that are able to both constrain participation on the platform (e.g., rules implemented in the algorithm) and allow participation on the platform (e.g., APIs, SDKs). In addition, we observe that platform-based meta-organizations deploy mechanisms that rely on algorithms such as the guided matching of actors. These mechanisms, that draw on vast amounts of data available in the networked information economy, were previously not available and thus were omitted by past studies on new forms of organizing.

Second, we expect to extend the literature on platform-based meta-organizations (Gawer 2014; Gulati et al. 2012) by a periphery-driven perspective on alignment taking the agency of digital technology and algorithms into account. The literature on meta-organizations is largely core-centered where it is assumed that “central actors actively shape the design of meta-organizations” (Gulati et al. 2012, p. 573). We observe that some mechanisms are beyond the direct influence of the central actor giving rise to mechanisms that exploit the taken for granted autonomy and periphery-driven alignment. Consider, for example, social feedback mechanisms where peripheral actors initiate communities by themselves (e.g., drawing on technological mechanisms provided by the platform such as feedback, rating, or communication) without being directly influenced by the platform owner. These mechanisms are important to consider because sometimes they facilitate alignment (e.g., when actors share positive experiences with other actors in the network) but sometimes they can lead to serious threats for the platform (e.g., when actors join forces to collectively strike the platform).

Opportunities for future research arise when considering the boundary conditions and limitations of this research in progress study. We limited the qualitative meta-analysis for this research in progress paper to a sub-sample of 16 representative studies in the context of platform-based meta-organizations. In our future development we plan to analyze the remaining studies from the sample and integrate the findings into this paper. In addition, we focused on the question of *what* key mechanisms enabled by digital technology can be identified for synthesizing autonomy and alignment in non-hierarchical meta-organizations. We plan to extend these insights by examining also *how* the identified mechanisms affect the level of autonomy and alignment. For example, some mechanisms such as standards for participation via certification enable platform owners to grant more autonomy to complementors that adhere to the platform owner’s goals and interests while facilitating core-driven alignment.

Another boundary condition of our study is the scalability of the identified mechanisms (Huang et al. 2017). We observed that some mechanisms (especially those where autonomy is granted by the owner and alignment is core-driven) are hardly scalable if they are not automated by using digital technology. One example is the guided access to knowledge for participation where the platform owner forms one-to-one relationships with complementors. Other mechanisms such as guided matching seem to be more scalable but require large amounts of data.

Despite these limitations and boundary conditions, we provide organizational and technical mechanisms that platform owners can deploy to reconcile autonomy and alignment at the same time. We point to mechanisms that platform owners can shape and influence and mechanisms that are beyond their agency but also facilitate periphery-driven alignment. Thus, also actors on the periphery (e.g., complementors or end users) can take our mechanisms to align themselves while retaining their high autonomy.

In conclusion, past discussions about new forms of organizing such as platform-based meta-organizations revolved around the question of whether mechanisms that solve the fundamental problem of organizing are fundamentally new. We conducted a qualitative meta-analysis in the context of platform-based meta-organizations as a new form of organizing and based our analysis on the assumption that these networked forms of organizing exhibit high degrees of autonomy yet facilitate ecosystem-wide alignment by leveraging the unique properties and architecture of digital technologies. We identified eight key mechanisms that we classified in a framework with the dimensions of autonomy (taken for granted or granted by owner) and alignment (core-driven or periphery-driven). The identification of organizational and technical mechanisms and classification into the framework allowed us to point out which mechanisms are altered by digital technology and which mechanisms are fundamentally new. In addition, the framework extends the largely core-driven perspective on meta-organizations by a periphery-driven perspective on mechanisms for platform-based meta-organizations.

6. References

- Adner, R. 2017. "Ecosystem as Structure: An Actionable Construct for Strategy," *Journal of Management* (43:1), pp. 39-58.
- Ahuja, M. K., and Carley, K. M. 1999. "Network Structure in Virtual Organizations," *Organization Science* (10:6), pp. 741-757.
- Alaimo, C., Kallinikos, J., and Valderrama, E. 2020 "Platforms as Service Ecosystems: Lessons from Social Media," *Journal of Information Technology* (35:1), pp. 25-48.
- Ashford, S. J., Caza, B. B., and Reid, E. M. 2018. "From Surviving to Thriving in the Gig Economy: A Research Agenda for Individuals in the New World of Work," *Research in Organizational Behavior* (38), pp. 23-41.
- Barrett, M., Oborn, E., and Orlikowski, W. 2016. "Creating Value in Online Communities: The Sociomaterial Configuring of Strategy, Platform, and Stakeholder Engagement," *Information Systems Research* (27:4), pp. 665-991.
- Benkler, Y. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven, CT, USA: Yale University Press.
- Berente, N., Lyytinen, K., Yoo, Y., and Maurer, C. 2019. "Institutional Logics and Pluralistic Responses to Enterprise System Implementation: A Qualitative Meta-Analysis," *MIS Quarterly* (43:3), pp. 873-902.
- Bergvall-Kåreborn, B., and Howcroft, D. 2014. "Persistent Problems and Practices in Information Systems Development: A Study of Mobile Applications Development and Distribution," *Information Systems Journal* (24:5), pp. 425-444.
- Boudreau, K. J. 2012. "Let a Thousand Flowers Bloom? An Early Look at Large Numbers of Software App Developers and Patterns of Innovation," *Organization Science* (23:5), pp. 1409-1427.
- Burtch, G., Carnahan, S., and Greenwood, B. N. 2018. "Can You Gig It? An Empirical Examination of the Gig Economy and Entrepreneurial Activity," *Management Science* (64:12), pp. 5497-5520.
- Cappelli, P., and Keller, J. R. 2013. "Classifying Work in the New Economy," *Academy of Management Review* (38:4), pp. 575-596.
- Cennamo, C., and Santaló, J. 2019. "Generativity Tension and Value Creation in Platform Ecosystems," *Organization Science* (30:3), pp. 617-641.
- Chandler, A. D. 1962. *Strategy and Structure*. Cambridge: MIT Press.
- Chandler, A. D. 1977. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge, Massachusetts, United States: Harvard University Press.
- Chen, D. L., and Horton, J. J. 2016. "Research Note—Are Online Labor Markets Spot Markets for Tasks? A Field Experiment on the Behavioral Response to Wage Cuts," *Information Systems Research* (27:2), pp. 403-423.
- Combs, J. G., Crook, T. R., and Rauch, A. 2019. "Meta-Analytic Research in Management: Contemporary Approaches, Unresolved Controversies, and Rising Standards," *Journal of Management Studies* (56:1), pp. 1-18.
- Curchod, C., Patriotta, G., Cohen, L., and Neysen, N. 2019. "Working for an Algorithm: Power Asymmetries and Agency in Online Work Settings," *Administrative Science Quarterly* (in Press), pp. 1-33.
- Cusumano, M. A., Gawer, A., and Yoffie, D. B. 2019. *The Business of Platforms: Strategy in the Age of Digital Competition, Innovation, and Power*. New York: HarperBusiness.
- de Reuver, M., Sørensen, C., and Basole, R. C. 2018. "The Digital Platform: A Research Agenda," *Journal of Information Technology* (33:2), pp. 124-135.
- Dhanaraj, C., and Parkhe, A. 2006. "Orchestrating Innovation Networks," *Academy of Management Review* (31:3), pp. 659-669.
- Eaton, B., Elaluf-Calderwood, S., Sørensen, C., and Yoo, Y. 2015. "Distributed Tuning of Boundary Resources: The Case of Apple's Ios Service System," *MIS Quarterly* (39:1), pp. 217-243.
- Faraj, S., Pachidi, S., and Sayegh, K. 2018. "Working and Organizing in the Age of the Learning Algorithm," *Information and Organization* (28:1), pp. 62-70.
- Fjeldstad, Ø. D., Snow, C. C., Miles, R. E., and Lettl, C. 2012. "The Architecture of Collaboration," *Strategic Management Journal* (33:6), pp. 734-750.
- Foerderer, J., Kude, T., Schuetz, S., and Heinzl, A. 2019. "Knowledge Boundaries in Enterprise Software Platform Development: Antecedents and Consequences for Platform Governance," *Information Systems Journal* (29:1), pp. 119-144.

- Gabriel, Y. 2005. "Glass Cages and Glass Palaces: Images of Organization in Image-Conscious Times," *Organization* (12:1), pp. 9-27.
- Gawer, A. 2014. "Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework," *Research Policy* (43:7), pp. 1239-1249.
- Ghazawneh, A., and Henfridsson, O. 2013. "Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model," *Information Systems Journal* (23:2), pp. 173-192.
- Gouldner, A. W. 1954. *Patterns of Industrial Bureaucracy*. The Free Press.
- Gregory, R. W., Henfridsson, O., Kaganer, E., and Kyriakou, H. 2020. "The Role of Artificial Intelligence and Data Network Effects for Creating User Value," *Academy of Management Review* (forthcoming).
- Gregory, R. W., Kaganer, E., Henfridsson, O., and Ruch, T. J. 2018. "It Consumerization and the Transformation of It Governance," *MIS Quarterly* (42:4), pp. 1225-1253.
- Gulati, R., Puranam, P., and Tushman, M. 2012. "Meta-Organization Design: Rethinking Design in Interorganizational and Community Contexts," *Strategic Management Journal* (33:6), pp. 571-586.
- Habersang, S., Küblerling-Jost, J., Reihlen, M., and Seckler, C. 2019. "A Process Perspective on Organizational Failure: A Qualitative Meta-Analysis," *Journal of Management Studies* (56:1), pp. 19-56.
- Heckscher, C. 1994. "Defining the Post-Bureaucratic Type," in *The Post-Bureaucratic Organization: New Perspectives on Organizational Change*, C. Heckscher and A. Donnellon (eds.). Thousand Oaks: SAGE Publications, pp. 14-62.
- Heckscher, C., and Donnellon, A. (eds.). 1994. *The Post-Bureaucratic Organization*. Thousand Oaks: SAGE Publications.
- Hoon, C. 2013. "Meta-Synthesis of Qualitative Case Studies: An Approach to Theory Building," *Organizational Research Methods* (16:4), pp. 522-556.
- Huang, J., Henfridsson, O., Liu, M. J., and Newell, S. 2017. "Growing on Steroids: Rapidly Scaling the User Base of Digital Ventures through Digital Innovation," *MIS Quarterly* (41:1), pp. 301-314.
- Huang, N., Burtch, G., Hong, Y., and Pavlou, P. A. 2020. "Unemployment and Worker Participation in the Gig Economy: Evidence from an Online Labor Market," *Information Systems Research* (31:2), pp. 431-448.
- Huber, T. L., Kude, T., and Dibbern, J. 2017. "Governance Practices in Platform Ecosystems: Navigating Tensions between Cocreated Value and Governance Costs," *Information Systems Research* (28:3), pp. 563-584.
- Jacobides, M. G., Cennamo, C., and Gawer, A. 2018. "Towards a Theory of Ecosystems," *Strategic Management Journal* (39:8), pp. 2255-2276.
- Karhu, K., Gustafsson, R., and Lyytinen, K. 2018. "Exploiting and Defending Open Digital Platforms with Boundary Resources: Android's Five Platform Forks," *Information Systems Research* (29:2), pp. 253-523.
- Katz, F. E. 1965. "Explaining Informal Work Groups in Complex Organizations: The Case for Autonomy in Structure," *Administrative Science Quarterly* (10:2), pp. 204-223.
- Kazan, E., Tan, C.-W., Lim, E. T. K., Sørensen, C., and Damsgaard, J. 2018. "Disentangling Digital Platform Competition: The Case of UK Mobile Payment Platforms," *Journal of Management Information Systems* (35:1), pp. 180-219.
- Kuhn, K. M., and Maleki, A. 2017. "Micro-Entrepreneurs, Dependent Contractors, and Instaserts: Understanding Online Labor Platform Workforces," *Academy of Management Perspectives* (31:3), pp. 183-200.
- Leong, C., Pan, S. L., Leidner, D. E., and Huang, J. S. 2019. "Platform Leadership: Managing Boundaries for the Network Growth of Digital Platforms," *Journal of the Association for Information Systems* (20:10), pp. 1531-1565.
- Mazmanian, M., Orlikowski, W. J., and Yates, J. 2013. "The Autonomy Paradox: The Implications of Mobile Email Devices for Knowledge Professionals," *Organization Science* (24:5), pp. 1337-1357.
- Moehlmann, M., Zalmanson, L., Henfridsson, O., and Gregory, R. W. 2020. "Algorithmic Management of Work on Online Labor Platforms: When Matching Meets Control," *Unpublished Working Paper* (Under Review).
- Nischak, F., Hanelt, A., and Kolbe, L. 2017. "Unraveling the Interaction of Information Systems and Ecosystems - a Comprehensive Classification of Literature," *Proceedings of the 38th International Conference on Information Systems*, Seoul.
- Noblit, G. W., and Hare, R. D. 1988. *Meta-Ethnography: Synthesizing Qualitative Studies*, (11 ed.). SAGE.

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- Petriglieri, G., Ashford, S. J., and Wrzesniewski, A. 2018. "Agony and Ecstasy in the Gig Economy: Cultivating Holding Environments for Precarious and Personalized Work Identities," *Administrative Science Quarterly* (64:1), pp. 124-170.
- Puranam, P., Alexy, O., and Reitzig, M. 2014. "What's "New" About New Forms of Organizing?," *Academy of Management Review* (39:2), pp. 162-180.
- Qiu, Y., Gopal, A., and Hann, I.-H. 2017. "Logic Pluralism in Mobile Platform Ecosystems: A Study of Indie App Developers on the Ios App Store," *Information Systems Research* (28:2), pp. 225-249.
- Reed, M. 2005. "Beyond the Iron Cage? Bureaucracy and Democracy in the Knowledge Economy and Society," in *The Values of Bureaucracy*, P.D. Gay (ed.). Oxford University Press, pp. 115-140.
- Rolland, K. H., Mathiassen, L., and Rai, A. 2018. "Managing Digital Platforms in User Organizations: The Interactions between Digital Options and Digital Debt," *Information Systems Research* (29:2), pp. 419-443.
- Rosenblat, A., and Stark, L. 2016. "Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers," *International Journal of Communication* (10), pp. 3758-3784.
- Selander, L., Henfridsson, O., and Svahn, F. 2013. "Capability Search and Redeem across Digital Ecosystems," *Journal of Information Technology* (28:3), pp. 183-197.
- Suchman, M. C. 1995. "Managing Legitimacy: Strategic and Institutional Approaches," *Academy of Management Review* (20:3), pp. 571-610.
- Taylor, J., and Joshi, K. D. 2019. "Joining the Crowd: The Career Anchors of Information Technology Workers Participating in Crowdsourcing," *Information Systems Journal* (29:3), pp. 641-673.
- Tilson, D., Lyytinen, K., and Sørensen, C. 2010. "Digital Infrastructures: The Missing Is Research Agenda," *Information Systems Research* (21:4), pp. 748-759.
- Tiwana, A., Konsynski, B., and Bush, A. A. 2010. "Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics," *Information Systems Research* (21:4), pp. 675-687.
- von Hippel, E. 2005. *Democratizing Innovation*. Cambridge, MA: MIT Press.
- Wareham, J., Fox, P. B., and Cano Giner, J. L. 2014. "Technology Ecosystem Governance," *Organization Science* (25:4), pp. 1195-1215.
- Weber, M. 1946. *From Max Weber: Essays in Sociology*. New York: Oxford University Press.
- Wood, A. J., Graham, M., Lehdonvirta, V., and Hjorth, I. 2019. "Good Gig, Bad Gig: Autonomy and Algorithmic Control in the Global Gig Economy," *Work, Employment and Society* (33:1), pp. 56-75.
- Yoo, Y., Boland, J. R. J., Lyytinen, K., and Majchrzak, A. 2012. "Organizing for Innovation in the Digitized World," *Organization Science* (23:5), pp. 1398-1408.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. 2010. "Research Commentary—the New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research," *Information Systems Research* (21:4), pp. 724-735.
- Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., and Faraj, S. 2007. "Information Technology and the Changing Fabric of Organization," *Organization Science* (18:5), pp. 749-762.

Essay 3: The Diverging and Converging of Multiple Partners in Digital Platform Development

Author: Tobias Mini, University of Passau, Germany

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Abstract

When individual firms want to develop a digital platform to become “platform owners,” they can often only meet either technological or market demands. To meet both demands at the same time, they may pool their resources and skills with other firms in a strategic alliance when jointly developing a digital platform. Motivated by the fact that this joint platform development challenges established assumptions of prior platform development research, we explore how multiple platform owners can reconcile both technological and market demands when jointly developing a digital platform. For this purpose, we studied an ideation platform that is developed by multiple platform owner firms by applying techniques of grounded theory. Our findings reveal that the firms in the strategic alliance dynamically “diverge and converge” when they coordinate the platform development. The partners diverge through the mechanisms of “scaffolding technology” and “checking evolution,” and they converge through the mechanism of “translating demands.”

The Diverging and Converging of Multiple Partners in Digital Platform Development

Completed Research Paper

Introduction

Firms or individuals that want to develop a digital platform to become “platform owners” have to meet both technological and market demands that often contradict each other (Qiu et al. 2017) and that are highly uncertain (Dattée et al. 2018). For example, developing a superior platform technology requires time which may contradict with early market entry. Especially individual firms often do not have good enough visibility on the needs that potential platform users may demand in order to design the platform technology attractive to them (Dattée et al. 2018) or do not possess the resources and skills to develop and launch a platform ahead of their competitors (Murthy and Madhok 2021). In other words, individual firms often can only meet either technological or market demands, but not both, when developing a digital platform (Murthy and Madhok 2021; Shi et al. 2021). What if an individual firm would pool its resources and skills with other firms in a strategic alliance (Furr and Shipilov 2018; Jacobides et al. 2018; Shipilov and Gawer 2020) to meet both technological and market demands at the same time when jointly developing a digital platform? This joint platform development may benefit these partnering firms with sharing of development costs, “survival of the fittest” ideas and technologies, and ongoing feedback (Eisenmann et al. 2009) but also requires complex coordination between and within the firms in the alliance (Hekkala et al. 2022).

Previous research highlights that digital platforms not only entail a layered-modular technological architecture and a market with multiple sides, but also enable the orchestration of value-creating interactions between multiple stakeholders (de Reuver et al. 2018; Gawer 2014; Tiwana et al. 2010; Yoo et al. 2010). Consequently, developing a digital platform requires to meet both technological and market demands while attracting multiple different stakeholders to form a larger digital ecosystem around the platform (Dattée et al. 2018; Eisenmann et al. 2011; Gawer and Cusumano 2008; Hagi 2009; Murthy and Madhok 2021; Saarikko et al. 2019; Shi et al. 2021; Tan et al. 2015). While previous literature has started to shed light on these and other characteristics of platform development, we still have little in-depth understanding of the functioning of platform development and the conditions under which a strategic alliance can be a viable alternative to classical information systems (IS) development project organizations (Hekkala et al. 2022). Thus, joint platform development through a strategic alliance is an important research topic, especially in the Information Systems discipline, because of the combination of technological, market-related, and organizational aspects of IS development.

To better understand the characteristics of joint platform development, previous IS development research in the context of platforms has started to broaden the traditional focus of IS development on software engineering to market-related and (inter-)organizational aspects (Bergvall-Kåreborn and Howcroft 2014; Qiu et al. 2017). The phenomenon of joint platform development that we study challenges at least three assumptions of prior research on IS development in the context of platforms. First, firms that want to develop a digital platform (i.e., prospective platform owners) are not only technology providers and market-makers but also orchestrators that connect with multiple partners. Second, platform development is not only a software engineering process but also entails the creation of a larger digital ecosystem. Third, approaches aimed at balancing technological and market demands in platform development typically span firm boundaries. These challenged assumptions associated with platform development in a strategic alliance setting motivate a fresh perspective on IS development and a critical discussion of the unique mechanisms that underly joint platform development (Qiu et al. 2017).

In this paper, we take the perspective of multiple platform owner firms that jointly develop a digital platform which allows us to address the following research question: *How can multiple platform owners reconcile both technological and market demands when jointly developing a digital platform?*

To answer this research question, this paper presents an in-depth case study where a firm specialized on software development (i.e., TechnologyCompany) formed a strategic alliance with three other firms that had expertise in innovation management (i.e., PartnerCompanies) with the common objective to develop a digital ideation platform. In this case setting, TechnologyCompany developed the platform software to meet

technological demands and the PartnerCompanies attracted potential users to the platform to satisfy market demands while they jointly acted as platform owners. Our emergent findings from the case study reveal that the platform owner firms in the strategic alliance dynamically “diverge and converge” when they coordinate the platform development between and within their firms. The partners diverge through the mechanism of “scaffolding technology” where features of the platform were developed that may be needed in the future to tackle high uncertainty and to reduce future effort in platform development. This mechanism is counterbalanced by “checking evolution” where feedback on platform features is gathered from potential users to steer the general direction of the platform. The partners converge through the mechanism of “translating demands” where the stakeholders constantly align themselves and create a common understanding for technological and market demands of the platform. The dynamic of “diverging and converging” between the platform owner firms identified in this paper explains how multiple platform owners can collaborate (Furr and Shipilov 2018; Jacobides et al. 2018; Shipilov and Gawer 2020) to reconcile technological and market demands when developing a digital platform (Qiu et al. 2017; Tan et al. 2015).

Conceptual Background

Digital Platforms and Strategic Alliances

To study digital platforms, past research followed mainly three perspectives: economic, engineering, and organizational (Gawer 2014). First, the economic perspective considers two- or multisided markets that mediate interactions between two or multiple market sides and emphasizes the importance of (cross-side) network effects (i.e., increasing the number of users on one side of the platform makes it more valuable to the users on the other side (Eisenmann et al. 2006)). Second, from the engineering design perspective, platforms are seen as layered-modular technological architectures with core and peripheral components (Baldwin and Woodard 2009; Tiwana et al. 2010; Yoo et al. 2010). The core of a digital platform consists of “the extensible codebase of a software-based system that provides core functionality” (Tiwana et al. 2010, p. 675). In this paper we adopt the third perspective, the organizational perspective on platforms, that integrates the economic and engineering perspectives (Gawer 2014). Accordingly, we define digital platforms as meta-organizations that entail a layered-modular technological architecture, comprise of a market with multiple sides, and enable the orchestration of value-creating interactions between multiple stakeholders (de Reuver et al. 2018; Gawer 2014; Tiwana et al. 2010; Yoo et al. 2010). The different stakeholders (i.e., individuals or firms) that develop and participate on digital platforms such as platform owners, complementors, or platform users form a larger digital ecosystem (Jacobides et al. 2018).

Especially emphasized in platform ecosystems is the alignment between the different stakeholders (e.g., platform owners and other platform users) with system-level goals and objectives (Adner 2017). Platform owners can be divided into two roles. First, platform providers perform business-related activities by mediating users’ interactions and serving as the user’s primary point of contact with the platform. Second, platform sponsors perform technology-related activities by developing and modifying the platform’s technology and deciding on who can participate on the digital platform (Eisenmann 2008; Eisenmann et al. 2009). These two roles can also be taken by different firms that collaborate and form strategic partnerships by combining their resources and skills (Eisenmann et al. 2009).

Firms can improve their performance when they interact with other firms that have complementary resources, technologies, or market access by finding partners that normally would not work with one another and then connect them through a multi-party, strategic alliance (Shipilov and Gawer 2020), i.e., an inter-organizational relationship where two (or more) organizations pool their resources in order to achieve a common objective (Gulati 1998). These ecosystems led by several alliance partners might be more suitable in environments with extreme uncertainty, where direct collaboration of multiple partners with very different resources and skills is needed to create value (Shipilov and Gawer 2020). Typically, an “orchestrator” company connects multiple partners and encourages them to combine their diverse resources and work directly with one another (Dhanaraj and Parkhe 2006; Furr and Shipilov 2018). Furr and Shipilov (2018) show that such alliances between organizations can help them build new platform ecosystems. In other words, strategic partners can combine their resources and skills in a strategic alliance to meet both technological and market demands (Furr and Shipilov 2018; Shipilov and Gawer 2020) with the common objective to develop a digital platform.

IS Development in the Era of Digital Platforms

The development of information systems such as digital platforms requires to reconcile both technological and market demands (Avison and Fitzgerald 2003; Bergvall-Kåreborn and Howcroft 2014; Qiu et al. 2017). Technological demands typically arise through software engineering principles that involve the “application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software” (Abran et al. 2004, p. 1). Besides these mere “non-functional” requirements, software engineering also requires creative and aesthetic components such as usability or user interface (UI) and user experience (UX) design which adds an enjoyment-based and intrinsic motivation to software developers (Shah 2006). Market demands, on the other hand, arise through financial and market goals when developing software which materialize, for example, as development costs, development time, revenues, or profitability (Harter et al. 2000). To reconcile technological and market demands within traditional organizations or in outsourcing relationships (Avison and Fitzgerald 2003), various IS development methods such as the systems development life cycle (SDLC) or agile methods have been developed (Lee and Xia 2010).

With the emergence of technology-enabled meta-organizations (Gulati et al. 2012) such as digital platform ecosystems (Jacobides et al. 2018; Tiwana et al. 2010; Wareham et al. 2014), research on IS development tends to broaden its traditional focus on software engineering and the cost vs. quality trade-off (e.g., Harter et al. 2000; Krishnan et al. 2000), to the formation of a larger digital ecosystem. In digital platforms, the platform owner “has a dual role as technology provider and market-maker” (Qiu et al. 2017, p. 245). In other words, it is important for firms that want to become “platform owners” to simultaneously consider both business and technology aspects of platforms (Gawer and Cusumano 2008). For instance, a platform owner cannot hope to succeed in a market it does not understand, regardless of its technical resources and skills. Likewise, even with a fully developed business case and fruitful dialogue with potential users, a platform owner still needs technical resources and skills to provide a technical architecture that offers sufficient functionality (Saarikko et al. 2019). Besides developing a layered-modular technological architecture, it is also important for prospective platform owners to attract potential users or complementors to the platform (Hagiu 2009; Shi et al. 2021) and to promote self-organization among the stakeholders (Tan et al. 2015). However, attracting participation is difficult for a platform owner because platform development is characterized by high uncertainty in which prospective platform owners often do not have good enough visibility on the needs that potential platform users may demand in order to design the platform technology attractive to them (Dattée et al. 2018).

While previous literature has started to shed light on these and other characteristics of platform development, we still have little in-depth understanding of the conditions under which a strategic alliance can be a viable alternative to classical information systems (IS) development project organizations (Hekkala et al. 2022). Especially three characteristics of joint platform development through strategic alliance partners challenge established assumptions (Alvesson and Sandberg 2013) of research on platform development in particular and IS development in general.

First, a platform owner is not only technology provider and market-maker, as assumed in prior research on platform development (Qiu et al. 2017), but also an orchestrator that connects with multiple partners and encourages them to combine their different resources and skills to work together (Dhanaraj and Parkhe 2006; Furr and Shipilov 2018; Jacobides et al. 2018; Shipilov and Gawer 2020). This is a significant departure from past research, where the platform owner only provided the technological resources and reinforced selected norms about quality but also influenced the form and degree of competition through its policies, thereby directly influencing platform user strategies and processes (Qiu et al. 2017).

Second, platform development is not only a software engineering process, as often assumed in traditional IS development research, but also entails the creation of a larger digital ecosystem. Firms that want to develop a digital platform do not only have to reconcile the cost vs. quality trade-off associated with developing software (e.g., Harter et al. 2000; Krishnan et al. 2000), while allowing the market to influence the adoption and diffusion of the developed software. By contrast, the platform owner also has to form an ecosystem by attracting potential users or complementors and building a market around the platform to facilitate efficient interactions between the different platform users.

Third, while traditional IS development methods (e.g., agile methods) may remain within traditional organizations or in outsourcing relationships even in the new era of platforms (Qiu et al. 2017), approaches for reconciling technological and market demands in digital platform development typically span

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organizational boundaries. Approaches for developing a digital platform include attracting participation (Hagiu 2009), promoting self-organization and collective identity by members (Tan et al. 2015), developing an appropriate business model (Shi et al. 2021), building awareness of the market or technology (Saarikko et al. 2019), adjusting the scope of the platform by developing complements internally or externally, “coring” by identifying and designing features for the platform and “tipping” by absorbing features from other platforms (Gawer and Cusumano 2008), or multiple firms pooling their resources and skills in a strategic alliance in order to develop a digital platform (Furr and Shipilov 2018; Jacobides et al. 2018; Shipilov and Gawer 2020). These three refined assumptions invite an investigation of how multiple platform owners can reconcile both technological and market demands when jointly developing a digital platform.

Methodology

To answer our research question, we studied an ideation platform that is developed by multiple platform owner companies to build grounded theory from empirical observations (Urquhart 2013). The case offers the opportunity for theory building regarding the new phenomenon that multiple platform owner firms form a strategic alliance to develop a digital platform through the in-depth analysis of an exemplary and unique case and therefore may be seen as a “revelatory case” (Eisenhardt and Graebner 2007; Yin 2009, p. 48). Analyzing the case allowed us to identify mechanisms (Bunge 2004) that explain how multiple platform owners can reconcile technological and market demands when developing a platform to generalize from description to theory (Lee and Baskerville 2003).

Data Collection and Theoretical Sampling

We collected and analyzed multiple sources of evidence (Gerring 2006) including ten semi-structured interviews with key stakeholders of the ideation platform development project and archival data on platform use cases and user experiences resulting in 123 pages of case material (see Table 1).

Method	Sources
10 semi-structured interviews (recorded and transcribed; writing of field notes)	We interviewed key stakeholders of the ideation platform development project from TechnologyCompany and PartnerCompanies including the <i>Founder</i> who had the initial idea of developing the digital platform and who holds shares on the platform, the <i>Partnership Manager</i> who was responsible for the relationship management with PartnerCompanies, identified technological requirements and potential users, and directed the development team, <i>Developers 1 and 2</i> whose responsibilities were full-stack development (including back-end, front-end, infrastructure design, and deployment management), the <i>UX Designer</i> who created mockups and designed user interfaces, an <i>IT Architecture Manager</i> who made key architectural decisions such as which standards to use during development, <i>Market Analysts 1 and 2</i> from PartnerCompanies who analyzed potential use cases and markets, a <i>Lead User</i> who tested the platform, and a <i>Business Development Manager</i> who was responsible for attracting potential users to the platform.
Archival data	Product information and website information which consisted of use cases and experiences from users of the digital platform.
Informal dialogue	We attended a meeting with the founder and architecture manager and regularly communicated with key stakeholders of the ideation platform development project.
Table 1. Data Collection	

The starting point for this study was the observation that a firm specialized on software development, hereafter referred to as TechnologyCompany, formed a strategic alliance with three other firms that had expertise in innovation management, hereafter referred to as PartnerCompanies, with the common objective to develop a digital ideation platform. We joined the joint platform development project after an initial prototype of the platform was developed and a significant reimplementaion was pending. Over the

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course of two years, we interviewed ten key stakeholders of the ideation platform development project from TechnologyCompany and PartnerCompanies (see Table 1). From these interviews, six were conducted with stakeholders from TechnologyCompany which allowed us to particularly understand how technological demands were met and the motivation behind forming a strategic alliance for the purpose of platform development from the perspective of TechnologyCompany. The remaining four interviews were held with stakeholders from PartnerCompanies to understand how market demands were met by the alliance partners. The interviews lasted 30 – 60 minutes and were held face-to-face by two researchers. We complemented these interviews with archival data including product information and website information which consisted of use cases and experiences from users of the digital platform. Our analysis of the dataset surfaced the dynamic of “diverging and converging” between the firms in the strategic alliance as the overarching theme of our study and allowed us to conceptualize three analytical categories – “scaffolding technology,” “checking evolution,” and “translating demands” – that in combination speak to the emerging core category of “diverging and converging.”

Data Analysis

Data analysis and collection activities were intertwined and we used techniques of grounded theory (Birks et al. 2013; Charmaz 2006; Gioia et al. 2013; Urquhart 2013) to analyze the collected case material and to iteratively build inductive theory. Open coding (Glaser and Strauss 1967) of the different data sources was performed using the coding software MAXQDA, which led to initial first-order categories (Gioia et al. 2013) that remained close to our data. Exemplary first-order categories were “preparing technology by estimating future business requirements” and “developing functionality that may be needed in the future.” Following open coding, as the second step, we constantly compared first-order categories to identify relationships and to aggregate them into second-order themes (Gioia et al. 2013). For example, the two first-order categories mentioned above led to the second-order theme “estimating features.” In the third step, the emerging first-order categories were presented in two research workshops in front of experienced IS scholars where the results and challenges of the coding were discussed and we jointly aided in refining first-order categories, second-order themes, and conceptualizations of the final mechanisms (Gioia et al. 2013). For instance, over time we assessed that the second-order themes of “estimating features” and “developing based on principles” were closely related to developing features of the platform that may be needed in the future yet distinct from each other and bundled them into the mechanism of “scaffolding technology.” To maintain theoretical sensitivity (Glaser 1978) and to scale up our emerging theory (Urquhart 2013) we regularly compared emerging concepts with literature on platform development (e.g., Bergvall-Kåreborn and Howcroft 2014; Qiu et al. 2017; Tan et al. 2015). The iterative coding and theoretical development stopped when we achieved a reliable and valid treatment of the mechanisms. This theoretical saturation (Charmaz 2006; Glaser and Strauss 1967; Saunders et al. 2018) was visible when the number of new first-order categories emerging from each additional case material decreased and no new second-order themes or mechanisms emerged from the data.

Findings

Introduction to the Research Site and Setting

The case presented in this paper is an ideation platform developed by multiple firms that jointly act as platform owners. The first company, hereafter referred to as TechnologyCompany, is one of the largest information technology service providers in Germany with software development and IT consulting expertise and has a long history of serving as a major complementor for other prominent enterprise software platforms. TechnologyCompany formed a strategic alliance with three other firms (hereafter referred to as PartnerCompanies) that had expertise in innovation management, supported innovation activities, and had an extensive customer network. Their business expertise in planning and supporting innovation processes and the access to existing platform users complements the technical expertise of TechnologyCompany, as explained by one of the developers of the platform:

“The question is always: ‘Do I have the skillset in the team so that I can acquire new customers through the team or do I need it externally?’ Or the knowledge about the process. ‘Do I have that in the team or do I need it externally?’ In the opposite direction, ‘does the partner has the resources and possibilities to do the development?’ I think that should complement each other.”

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The companies in the strategic alliance are jointly developing an ideation platform that establishes an ecosystem with companies, start-ups, customers, and other stakeholders. According to the market analyst, the idea for the platform project “arose from the fact that there was a shortage on the market,” i.e., it was initiated through a “market pull.” The ideation platform provides the necessary technological architecture to bring together companies or start-ups that want to organize innovation events such as hackathons, design thinking workshops, innovation days, on one side of the platform market, and participants of these innovation events, on the other side of the platform market.

A Grounded Theory of Diverging and Converging Between Platform Owners

We delineate key mechanisms explaining diverging and converging between platform owners who jointly develop a digital platform: “translating demands,” “scaffolding technology,” and “checking evolution.” These mechanisms interact with each other to reconcile both technological and market demands when jointly developing a digital platform. The identified mechanisms along with their definitions and key themes are illustrated in Table 2.

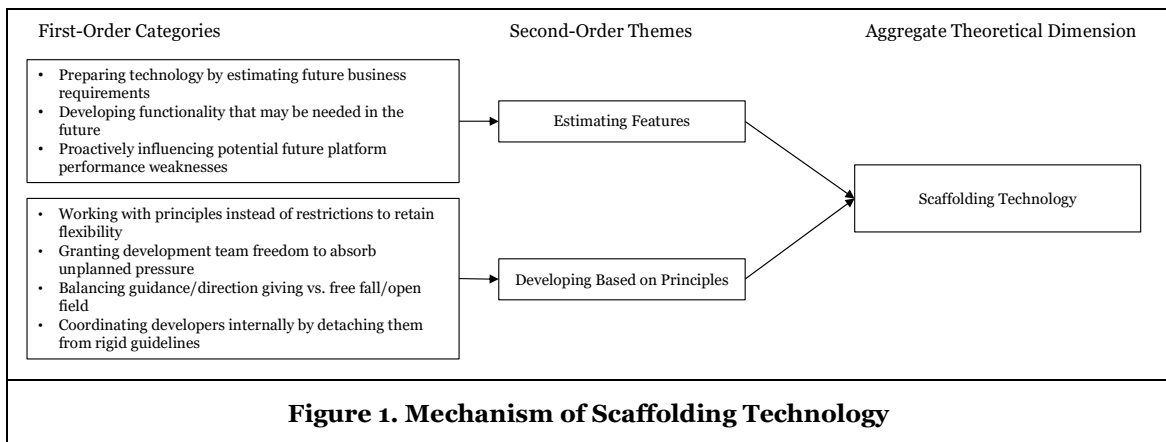
Mechanism	Definition	Themes
Scaffolding Technology	The mechanism by which features of the platform are implemented that may be needed in the future to tackle high uncertainty and to reduce future development effort.	<ul style="list-style-type: none"> □ Estimating Features: Platform core functionality that may be needed in the future is anticipated and implemented based on an emergent understanding of requirements. □ Developing Based on Principles: Stakeholders are granted freedom in development while adhering to non-rigid guidelines.
Checking Evolution	The mechanism by which potential users of the platform are identified and engaged to gather feedback on platform features to steer the direction of the platform.	<ul style="list-style-type: none"> □ Steering Development Trajectory: Adjusting the direction of the platform based on feedback. □ Generalizing Requirements: Platform requirements for potential users are inferred by gaining feedback from selected, early users.
Translating Demands	The mechanism by which the stakeholders constantly align themselves and create a common understanding for technological and market demands of the platform.	<ul style="list-style-type: none"> □ Creating Common Understanding: Technological and market demands are understood equally by all partnering stakeholders. □ Aligning Partners: Stakeholders share mutual agreement regarding their goals and actions and make joint decisions.

Table 2. Mechanisms That Explain Diverging and Converging Between Platform Owners

Scaffolding Technology

The mechanism of “scaffolding technology” explains how features of the platform that may be needed in the future are developed to tackle high uncertainty and to reduce future development effort. In this section, we name and elaborate two key themes of this mechanism (see Figure 1 for an overview of the key concepts and relationships) and provide illustrative examples.

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Estimating Features: TechnologyCompany, the platform owner firm that brought technological resources and skills to the partnership, aimed to develop a scalable platform from the beginning by estimating platform core features that may be needed in the future to deal with uncertainty regarding market demands as explained by the partnership manager:

“It is built in such a way that it can be scaled quite quickly in terms of infrastructure. How quickly the market might scale or not, that’s rather the difficult thing to estimate. That is the challenge.”

Since it was challenging for TechnologyCompany to anticipate how the user demand would develop in the future, they consciously designed the platform architecture in way that both opening or closing the platform for users is possible in the future as described by a developer:

“Whether you provide the platform for individual companies, or the platform remains open so that everyone can register, both are possible and both would also be scalable in the way the platform architecture is currently designed.”

Regarding the platform architecture, the architecture manager explained that TechnologyCompany “relied very heavily on lean, small-scale microservices with corresponding integration technologies” as the building blocks for the platform architecture and took these architecture building blocks into account right from the start. This would have allowed TechnologyCompany to flexibly exchange a microservice if the platform would have changed to a cloud-native application in the future, which “is then relatively manageable feasible” because the platform architecture is designed “in such a way that I then also have the opportunity to scale.”

Another example was given by this developer, in which the prediction of platform features resulted in a feature that was needed at a later point in time already being implemented, thus saving development effort:

“We also decided on Kubernetes¹, so that we are multitenant-capable, that was actually clear to us from the beginning. If we hadn’t decided on Kubernetes at an early stage, then it would probably have been incredibly difficult if this requirement had changed again, as we need more tenants now, but the requirement was actually there from the beginning.”

However, in retrospect the founder of the platform from TechnologyCompany alluded that while implementing estimated features, eventually resulting in a scalable architecture, might be important for platforms, fast market entry seems to be equally important:

“We are an IT company, we have set up the maximum performance stable architecture, so for such a fast-scaling business where you have to go to market very quickly, it is not the right decision at all, but rather go to market quickly first because with cloud solutions/platforms you have the possibility to improve it step by step anyway. So, the other way round in retrospect would have been smarter.”

¹ Kubernetes is an open-source system for automating the deployment, scaling, and management of software applications.

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The market analyst from PartnerCompanies concurred with the assessment of the founder, lamenting that *“speed is more important than technological excellence.”*

Another example was given where stakeholders implemented platform features for the user interface that later turned out to be unnecessary. The UX designer had to abolish these features afterwards, resulting in even more effort:

“In certain menu structures, for example, if you only have two menu items and a sidebar that always comes on. Something like that was simply called ‘more will be added later’; that could have been done differently from the start.... we almost thought too far.”

The anticipation and implementation of platform core functionality that may be needed in the future seems to be a novel approach in platform development, especially to tackle high uncertainty regarding unclear user needs in the market, but also bears the risk of abolishing features afterwards.

Developing Based on Principles: While stakeholders had the freedom to estimate and implement platform features in development, they also had to adhere to non-rigid guidelines. These guidelines included style guides, standardized components, or general principles regarding the duration of the project as explained by the UX designer:

“I had a lot of freedom except for some restrictions in the sense of it has to be quick, it has to look nice, and we mustn't stray too far from the material design standard. We had a set of illustrations that we could use over and over again like ‘empty states’ or ‘oops something went wrong’.”

This freedom in developing the platform led developers to establish their own principles, such as when dealing with new frameworks and technologies:

“If someone took a topic and worked on it and had to integrate some new frameworks, they automatically carried it on into the team. That was a principle to spread the knowledge well. There was also the principle that if a new framework should have been set up, then of course it had to be coordinated with the experienced developers.”

Some stakeholders, such as the UX designer, enjoyed the autonomy and freedom when developing the platform but also felt that overall guidance on the general direction of the platform was missing:

“We were a bit lost on the open field...because we didn't know exactly in which direction we were going. Should we pay more attention on this or will that be our best horse? I don't know. I also found it quite exciting to do it in the open field without any guidance, but it was also a bit of a ‘free fall’ because we didn't have any more guidance.”

Guidance on the general direction of the platform and on detailed decisions was given by PartnerCompanies through communication with TechnologyCompany as described by the founder:

“The example was the single sign-on where the customer didn't use a standard and we built that into the platform. We won't do that a second time now. But that's also what our colleagues from PartnerCompanies said, that wasn't so clever.”

Stakeholders involved in platform development seem to require autonomy and freedom while giving them guiding principles on the general direction of the platform through the partners.

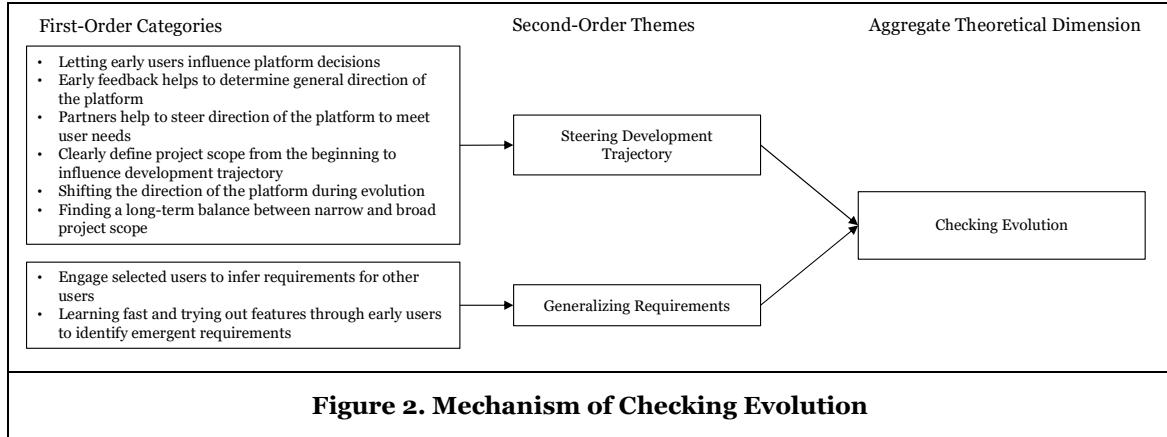
In summarizing the mechanism of “scaffolding technology,” by “estimating features” platform core features that may be needed in the future are implemented to deal with uncertainty regarding market demands and saving future development effort while being mindful to a fast market entry. Allowing stakeholders in platform development to estimate features requires “developing based on principles” where autonomy and freedom on the part of the stakeholders is assured while giving them non-rigid, guiding principles.

Checking Evolution

While the first identified mechanism described above places the estimation and principle-based development of platform core features at the forefront of platform development, additional data analysis surfaced a second mechanism that provides a “checks and balances” for this flexible development. The mechanism of “checking evolution” explains how potential users of the platform are identified and engaged to gather feedback on platform core features to steer the direction of the platform. This section describes

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the second-order themes of this mechanism (see Figure 2 for an overview of the key concepts and relationships) and includes supporting data.



Steering Development Trajectory: Typically the partners focused on market demands also have access to potential users of the platform, such as in the case of PartnerCompanies, and can provide guidance on the general direction of the platform. The founder of the platform described how the PartnerCompanies helped to adjust the general direction of the platform based on their in-depth market know how:

“We realized relatively quickly that the market was already a bit exhausted and our PartnerCompanies steered us in the direction of saying that innovation formats are actually what the market currently needs more than simply an ideation platform.”

To generate recommendations for the general direction of the platform, PartnerCompanies utilized their access to potential users to gather early feedback:

“We actually got the feedback relatively early and we then recognized practically immediately in which direction it goes, does it fit, does it not fit.”

These feedback rounds with potential users of the platform also allowed PartnerCompanies to derive concrete requirements which were subsequently passed to the developers from TechnologyCompany and vice versa. One of the developers described the process as follows:

“The requirements were set by the development partners, who then also got the feedback through some formats such as workshops, for example, ‘the platform would be better like this and so’ and then tipped it over to UI/UX design, then it went in the direction of development. From the direction of the development it was rather a feedback if technically necessary things have to be realized, i.e., you would like to have a chat, then the foundation of it is to create a websocket implementation.”

Another developer explained that certain platform features could only be identified and realized through feedback from PartnerCompanies’ engagement with potential platform users:

“There were the PartnerCompanies as contact persons who know the market well and they gave us requirements that were relevant from the customer’s point of view, i.e., how the platform should be structured, what kind of content should be included and then later on we had a feedback round with users of the platform and they had a completely different idea of the platform... they found out: ‘ah mobile is not supported very well, that hinders us in the innovation process, we can’t photograph our results, upload them’ and things like that weren’t even taken into account at the beginning.”

Partner and user feedback seems to be an important means to steer the general direction of the platform as well as to derive concrete requirements for platform core features.

Generalizing Requirements: Feedback from potential users and customers that came from PartnerCompanies also helped to identify the niche and positioning of the platform as the architecture manager explained based on an example:

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“You find out at the customer that there is some legal or data protection law, or some other accompanying phenomena coming from the market, that you simply can’t know at the beginning. I think that when I build such a platform the art is to find exactly the niche with exactly the positioning, with exactly the differentiation of this service that I would like to bring then.”

While the engagement of PartnerCompanies with potential users of the platform helped to identify new features and to adjust the general direction of the platform it also helped TechnologyCompany to generalize requirements identified from users to a broader set of customers as described by a developer:

“For example, the development of personas, user journeys, etc., that you specifically define a customer, then hold the requirements of the customer against the user stories, so that you can have the best possible estimate that you can serve all relevant target groups.”

In contrast, specializing on few selected users of the platform without generalizing requirements of these users to a broader set of customers was perceived negatively, for example by the founder:

“In retrospect, there is a chance that it could actually only has satisfied one customer. I think that was one of the areas of tension: do you respond to the customer or are you prepared to leave the customer behind and say ‘ok, if these are your requirements, we can’t serve them with the platform and then it’s just not the right thing for you’.”

The UX designer reflected on how an optimal approach to developing the platform would have looked like instead, but which was challenging as the partners often wanted to pursue their own agendas:

“In my opinion you should develop faster, just go and get something out there so you can test it, preferably early enough with end users so we can kind of get valuable feedback (fail hard, fail often, etc.) and so we could have thought it through a bit more. But that was really difficult because of stakeholders from the PartnerCompanies and stakeholders from TechnologyCompany, everyone wants to do their own thing. It was difficult to find a balance.”

Generalizing platform requirements for potential users by gaining feedback from selected, early users helped to identify new features and to adjust the general direction but also accompanies the danger of specializing too much on the features that the few early users demand.

In summary, the mechanism of “checking evolution” suggests that the direction of the platform can be evaluated and adjusted based on partner and user feedback through “steering development trajectory.” In addition, through “generalizing requirements” feedback from selected, early platform users can be leveraged for generalizing platform requirements to a broader set of potential users.

Translating Demands

The mechanism of “translating demands” explains how the stakeholders constantly align themselves and create a common understanding for technological and market demands of the platform (see Figure 3 for an excerpt from our data structure).

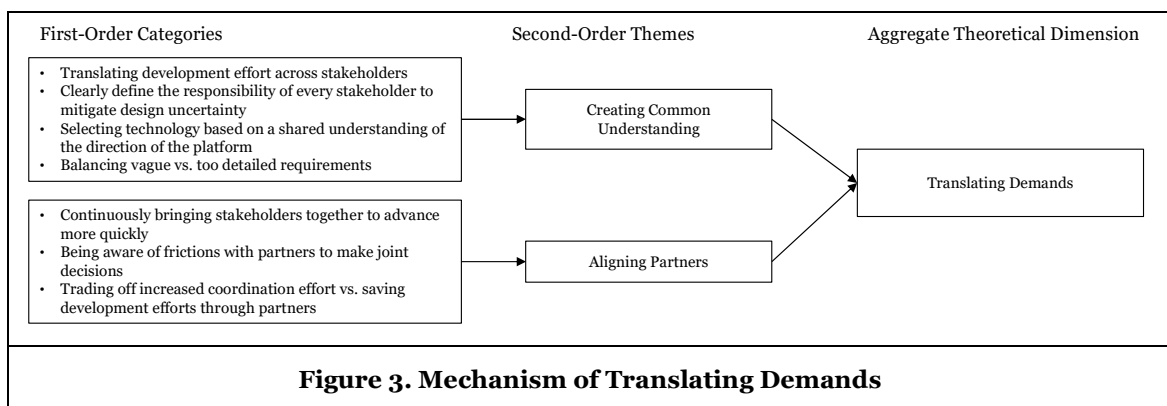


Figure 3. Mechanism of Translating Demands

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Creating Common Understanding: Bringing TechnologyCompany and the PartnerCompanies together, rather than each pursuing their own agenda, requires that technological and market demands are understood equally by all stakeholders. The market analyst described that especially differences at the (meta-)organizational level necessitate a common understanding among all stakeholders:

“I see the problem more at the organizational level. The fact is that TechnologyCompany and PartnerCompanies have a different culture leads to more discussions, and it takes longer to reach the same understanding.”

A developer described, based on an example, how a “common understanding” between the stakeholders was established:

“Development has a completely different understanding of what [technical updates] mean in operational implementation. For business that sounds like we are doing a security update. But what's behind it and what problems may arise later on are present in a different way than on the development side. To resolve this it usually helps to try to create a common understanding, to show, for example, what will it cost us later, also an evaluation of benefits, in order to convince both sides. Conversely, in the direction of development you have to create the understanding, we also want to be quick on the market. We can't always go for the latest technology; we need something stable.”

The continuous creation of a common understanding of technological and market demands has also led to both TechnologyCompany and the PartnerCompanies identifying themselves as joint “platform operators” as the partnership manager explained:

“The more often in the project, especially with a partner, everyone was at the same table, i.e., development, business, customer, the better it was for the whole thing, because there was much more mutual understanding and an agreement was reached more quickly.... So we are all responsible for this platform, we all have to make sure that it works together somehow. Understanding oneself as a kind of operator at the same time.”

Some stakeholders such as the UX designer perceived the creation of a common understanding with PartnerCompanies even as “fun to throw ideas into the room, to diverge a bit, to come closer” but after a major redesign of the platform, difficulties arose in creating a common understanding between TechnologyCompany and PartnerCompanies:

“We sat down together with different stakeholders, developers and people from our PartnerCompanies, and then we thought about ‘can we structure it better’ because the old version was difficult to navigate.... Then we tried to draw wireframes, then mockups, iteratively with all kinds of stakeholders together. Which is also not easy, especially if there are misunderstandings about how the styling should happen, for example. That's where everyone has an opinion because you can look at it and one person likes more cold colors and another person likes more warm colors.”

Creating a common understanding assures that technological and market demands are understood equally by all partnering stakeholders, clearing up any misunderstandings.

Aligning Partners: Stakeholders of the ideation platform development project from TechnologyCompany and the PartnerCompanies need to share mutual agreement regarding their goals and actions and make joint decisions. Aligning stakeholders contains a trade-off between, on the one hand, increased effort for coordinating the strategic alliance partners and, on the other hand, effort that can be saved by leveraging the partner's resources and skills such as access to potential platform users as a developer explained:

“As soon as you have another party involved (be it a development partner), there is this extra effort for coordination. But you may also have made this cooperation for certain reasons because then one or the other effort can be saved or [to access] a certain customer base. You have to weigh it all up.”

While the architecture manager suggested that a “permanent control” of the strategic alliance partners is necessary and thus increased coordination effort, the founder of the platform suggested to be aware of the interests and business model of the stakeholders, thus leveraging the partner's resources and skills:

“One of the lessons learned is that in the ideation platform project, where we are an IT company and our PartnerCompanies are innovation companies, and the users is to write down which stakeholders

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I have at all, who are involved in the platform, what are their interests, and not that they only want to push through their interests, but maybe they tick completely differently because their business model is also different.”

Similarly, the market analyst suggested to be aware of the “cultural fit” with potential partners already before and during the development of the platform:

“This cultural fit between companies has to be established beforehand, and various factors that have nothing to do with technology play a role here. And that is also the crux of ecosystems according to my interpretation. My recommendation is to take a good look at the partners and check how they fit together culturally.”

Nevertheless, the architecture manager highlighted that while it was inevitable for such a strategic alliance “to act in concert” it was also inevitable that each partner had room to maneuver:

“Each brings certain resources to this cooperation and they are always limited. That's why you inevitably have this line of conflict. And that's why it's an essential success for such a cooperation that you have the will to go through this together. And together, that one or the other perhaps also takes a step back and says: ‘Hey, maybe I'll try this out now’.”

Aligning goals and actions of alliance partners and stakeholders in platform development involves a trade-off between, on the one hand, increased effort for coordinating the strategic alliance partners and, on the other hand, effort that can be saved by leveraging the partner's resources and skills. Managing this trade-off requires that the alliance partners act in concert and make joint decisions.

In summary of this third mechanism of “translating demands,” through “creating common understanding” technological and market demands are understood equally by all partnering stakeholders while “aligning partners” leads to joint decisions between the stakeholders by sharing mutual agreement regarding their goals and actions.

Discussion

In this paper we explored how multiple platform owner companies can reconcile both technological and market demands when jointly developing a digital platform. Based on findings derived from a case study of an ideation platform that is developed by multiple firms in a strategic alliance, we identified the dynamic of “diverging and converging” between and within the platform owner firms which involves three mechanisms: “translating demands,” “scaffolding technology,” and “checking evolution.” In the following we discuss our findings with respect to (1) the literature on platform development and (2) the literature on strategic alliances.

Implications for Research

The first implication of our study is for research on platform development (Qiu et al. 2017; Tan et al. 2015) and platform ecosystem emergence in general (Dattée et al. 2018; Murthy and Madhok 2021). Our findings around the mechanism of “scaffolding technology” add to our emergent understanding of nascent platform development in which technological and market demands are often highly uncertain (Dattée et al. 2018). Our findings illustrate that this uncertainty of technological and market demands in platform development is tackled through “estimating features” by which platform core functionality that may be needed in the future is anticipated and implemented based on an emergent understanding of platform requirements (Lehmann et al. 2022). For example, our findings show that the platform architecture could be purposely designed in way that both opening or closing the platform for users is possible in the future (Boudreau 2010) which may provide some flexibility to respond to competitive strategies such as the exploitation of features (Eisenmann et al. 2011; Gawer and Cusumano 2008; Karhu et al. 2018). This estimation of platform core features typically requires “developing based on principles” by which stakeholders involved in platform development are granted freedom to implement features while adhering to non-rigid guidelines and principles. “Developing based on principles” implies that also internal developers require considerable autonomy to identify and implement platform core features and “internal complements” that may be needed in the future (Glaser 2020) but which is “disciplined” by using non-rigid guidelines and standards (Foerderer et al. 2019; Mithas and Kude 2017) similar to platform users or external complementors being

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granted autonomy while simultaneously being controlled (Huber et al. 2017; Hurni et al. 2021; Moehlmann et al. 2021). As developing features of the platform that may be needed in the future to tackle high uncertainty and to reduce future development effort may drive variety of the platform core to the detriment of quality (Cennamo 2018), “scaffolding technology” has to be counterbalanced with the mechanism of “checking evolution” by which potential users of the platform are identified and engaged to gather feedback on platform features to steer the general direction of the platform. While the platform owner typically incentivizes participation of potential platform users or complementors (Tan et al. 2015) and influences individual behavior of platform users in the ecosystem through its policies, processes, and culture (Qiu et al. 2017), our findings suggest that platform users, in turn, also can provide valuable feedback especially in nascent development to shape the platform’s evolution. Through “steering development trajectory,” the direction of the platform is continuously adjusted and updated based on feedback gathered from potential users which may be an additional means to become aware of market opportunities or constructing the platform in relation to market expectations (Saarikko et al. 2019; Shi et al. 2021). In addition, through “generalizing requirements” it would even be possible to infer platform requirements for potential users by gaining feedback from selected, early users which may be a source to explore new business models and requirements around the platform (Shi et al. 2021).

The second implication is for research on strategic alliances that have the purpose of platform ecosystem formation (Davis 2016; Furr and Shipilov 2018; Jacobides et al. 2018; Shipilov and Gawer 2020). We provide empirical evidence for how strategic alliances between multiple platform owners can be used “to set the ground for building an ecosystem” (Jacobides et al. 2018, p. 2275). Our findings related to the mechanism “translating demands” can help to explain how multiple stakeholders can be orchestrated and encouraged to combine their diverse resources and work directly with one another (Dhanaraj and Parkhe 2006; Furr and Shipilov 2018; Shipilov and Gawer 2020). In particular, “creating common understanding” can help to assure that technological and market demands are understood equally by all partnering stakeholders as especially at an early stage of ecosystem development the roles, the division of activities, and decisions of how value is created and how and by whom value is captured are often unclear as well as contested (Shipilov and Gawer 2020). In addition, our findings around “aligning partners” suggest that platform stakeholders are continuously brought together to generate information on the partners limited resources and skills which assures that they share mutual agreement regarding their goals and actions and make joint decisions (Adner 2017). Overall, our findings point to a dynamic of “diverging and converging” when the joint platform owners in the strategic alliance coordinate the platform development between and within their firms. Individual firms in the strategic alliance often autonomously isolate themselves and diverge (through the mechanisms of “scaffolding technology” and “checking evolution”), for example, when they perceive conflict with the partner (Davis 2016). The platform owners then connect back with each other and converge (through the mechanism of “translating demands”) to learn from each other and combine resources to further develop the platform (Furr and Shipilov 2018; Shipilov and Gawer 2020).

Implications for Practice

Especially platform owners in strategic alliances can gain utility from our findings. Our findings provide guidance through the challenging endeavor of jointly developing a digital platform. Platform development performed by strategic alliance partners (i.e., multiple prospective platform owners) may lead to sharing of development costs, “survival of the fittest” ideas and technologies, and ongoing feedback which may yield to a higher quality platform but also requires complex coordination processes among the strategic partners. Our findings show that the strategic alliance partners need to dynamically “diverge and converge.” The partners diverge through “scaffolding technology” where features of the platform are developed that may be needed in the future to tackle high uncertainty and to reduce future development effort. Through “checking evolution,” potential users of the platform are identified and engaged to gather feedback on platform features to steer the direction of the platform. The partners converge through “translating demands” where the stakeholders constantly align themselves and create a common understanding for technological and market demands of the platform.

Limitations and Future Research

Opportunities for future research follow from the limitations and boundary conditions of this study. First, in this paper we studied an ideation platform that mediates interactions between different platform users.

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Future research could validate our findings in other complex software development contexts such as the development of blockchains or in the context of platforms that involve complementary app developers. Second, in our case study setting four platform owner firms jointly developed the ideation platform. Future research could identify the optimal size of such a strategic alliance (Shipilov and Gawer 2020) or look into different alliance constellations of firms that collaborate with each other to develop a digital platform (e.g., triads) (Davis 2016). Last, while we identified the dynamic of “diverging and converging” between the platform owner firms in this paper, we did not focus on the dynamic push and pulls between both poles over time. Future research may unveil the longitudinal, dynamic interplay and balancing act of “diverging” (through the mechanisms of “scaffolding technology” and “checking evolution”) and “converging” (through the mechanism of “translating demands”) in digital platform development.

Conclusion

In conclusion, individual firms may pool their resources and skills with other firms in a strategic alliance to meet both technological and market demands at the same time when jointly developing a digital platform. Motivated by the fact that this joint platform development challenges established assumptions of prior platform development research, we explored how multiple platform owners can reconcile both technological and market demands when jointly developing a digital platform. For this purpose, we studied an ideation platform that is developed by multiple platform owner firms by applying techniques of grounded theory. We found that the firms in the strategic alliance dynamically “diverge and converge” when they coordinate the platform development. The partners diverge through the mechanisms of “scaffolding technology” and “checking evolution,” and they converge through the mechanism of “translating demands.”

References

- Abran, A., Moore, J. W., Bourque, P., and Dupuis, R. 2004. *Guide to the Software Engineering Body of Knowledge*. Los Alamitos, CA: IEEE Computer Society Press.
- Adner, R. 2017. "Ecosystem as Structure: An Actionable Construct for Strategy," *Journal of Management* (43:1), pp. 39-58.
- Alvesson, M., and Sandberg, J. 2013. *Constructing Research Questions: Doing Interesting Research*. London: SAGE Publications.
- Avison, D. E., and Fitzgerald, G. 2003. *Information Systems Development: Methodologies, Techniques and Tools*, (3 ed.). McGraw-Hill.
- Baldwin, C. Y., and Woodard, C. J. 2009. "The Architecture of Platforms: A Unified View," in: *Platforms, Markets and Innovation*, A. Gawer (ed.). Cheltenham: Edward Elgar Publishing, pp. 19-44.
- Bergvall-Kåreborn, B., and Howcroft, D. 2014. "Persistent Problems and Practices in Information Systems Development: A Study of Mobile Applications Development and Distribution," *Information Systems Journal* (24:5), pp. 425-444.
- Birks, D. F., Fernandez, W., Levina, N., and Nasirin, S. 2013. "Grounded Theory Method in Information Systems Research: Its Nature, Diversity and Opportunities," *European Journal of Information Systems* (22:1), pp. 1-8.
- Boudreau, K. 2010. "Open Platform Strategies and Innovation: Granting Access Vs. Devolving Control," *Management Science* (56:10), pp. 1849-1872.
- Bunge, M. 2004. "How Does It Work?: The Search for Explanatory Mechanisms," *Philosophy of the Social Sciences* (34:2), pp. 182-210.
- Cennamo, C. 2018. "Building the Value of Next-Generation Platforms: The Paradox of Diminishing Returns," *Journal of Management* (44:8), pp. 3038-3069.
- Charmaz, C. 2006. *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*. London: SAGE Publications.
- Dattée, B., Alexy, O., and Autio, E. 2018. "Maneuvering in Poor Visibility: How Firms Play the Ecosystem Game When Uncertainty Is High," *Academy of Management Journal* (61:2), pp. 466-498.
- Davis, J. P. 2016. "The Group Dynamics of Interorganizational Relationships: Collaborating with Multiple Partners in Innovation Ecosystems," *Administrative Science Quarterly* (61:4), pp. 621-661.
- de Reuver, M., Sørensen, C., and Basole, R. C. 2018. "The Digital Platform: A Research Agenda," *Journal of Information Technology* (33:2), pp. 124-135.
- Dhanaraj, C., and Parkhe, A. 2006. "Orchestrating Innovation Networks," *Academy of Management Review* (31:3), pp. 659-669.

Diverging and Converging of Partners in Platform Development

- Eisenhardt, K. M., and Graebner, M. E. 2007. "Theory Building from Cases: Opportunities and Challenges," *Academy of Management Journal* (50:1), pp. 25-32.
- Eisenmann, T. R. 2008. "Managing Proprietary and Shared Platforms," *California Management Review* (50:4), pp. 31-53.
- Eisenmann, T. R., Parker, G., and Van Alstyne, M. 2009. "Opening Platforms: How, When and Why?," in *Platforms, Markets and Innovation*, A. Gawer (ed.). Cheltenham, UK: Edward Elgar Publishing, pp. 131-162.
- Eisenmann, T. R., Parker, G., and Van Alstyne, M. W. 2006. "Strategies for Two-Sided Markets," *Harvard Business Review* (84:10), pp. 92-101.
- Eisenmann, T. R., Parker, G., and Van Alstyne, M. W. 2011. "Platform Envelopment," *Strategic Management Journal* (32:12), pp. 1270-1285.
- Foerderer, J., Kude, T., Schuetz, S., and Heinzl, A. 2019. "Knowledge Boundaries in Enterprise Software Platform Development: Antecedents and Consequences for Platform Governance," *Information Systems Journal* (29:1), pp. 119-144.
- Furr, N., and Shipilov, A. 2018. "Building the Right Ecosystem for Innovation," *MIT Sloan Management Review* (59:4), pp. 59-64.
- Gawer, A. 2014. "Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework," *Research Policy* (43:7), pp. 1239-1249.
- Gawer, A., and Cusumano, M. A. 2008. "How Companies Become Platform Leaders," *MIT Sloan Management Review* (49:2), pp. 68-75.
- Gerring, J. 2006. *Case Study Research: Principles and Practices*. Cambridge: Cambridge University Press.
- Gioia, D. A., Corley, K. G., and Hamilton, A. L. 2013. "Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology," *Organizational Research Methods* (16:1), pp. 15-31.
- Glaser, B. 1978. *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*. Mill Valley, CA: Sociology Press.
- Glaser, B. G., and Strauss, A. L. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*, (1 ed.). Chicago, IL: Aldine Publishing Company.
- Glaser, K. 2020. "Governance of Internal Complementors in Platform Ecosystems," in: *Proceedings of the 41st International Conference on Information Systems*. India.
- Gulati, R. 1998. "Alliances and Networks," *Strategic Management Journal* (19:4), pp. 293-317.
- Gulati, R., Puranam, P., and Tushman, M. 2012. "Meta-Organization Design: Rethinking Design in Interorganizational and Community Contexts," *Strategic Management Journal* (33:6), pp. 571-586.
- Hagiu, A. 2009. "Multi-Sided Platforms: From Microfoundations to Design and Expansion Strategies." Harvard Business School Strategy Unit Working Paper.
- Harter, D. E., Krishnan, M. S., and Slaughter, S. A. 2000. "Effects of Process Maturity on Quality, Cycle Time, and Effort in Software Product Development," *Management Science* (46:4), pp. 451-466.
- Hekkala, R., Stein, M.-K., and Sarker, S. 2022. "Power and Conflict in Inter-Organisational Information Systems Development," *Information Systems Journal* (32:2), pp. 440-468.
- Huber, T. L., Kude, T., and Dibbern, J. 2017. "Governance Practices in Platform Ecosystems: Navigating Tensions between Cocreated Value and Governance Costs," *Information Systems Research* (28:3), pp. 563-584.
- Hurni, T., Huber, T. L., Dibbern, J., and Krancher, O. 2021. "Complementor Dedication in Platform Ecosystems: Rule Adequacy and the Moderating Role of Flexible and Benevolent Practices," *European Journal of Information Systems* (30:3), pp. 237-260.
- Jacobides, M. G., Cennamo, C., and Gawer, A. 2018. "Towards a Theory of Ecosystems," *Strategic Management Journal* (39:8), pp. 2255-2276.
- Karhu, K., Gustafsson, R., and Lyytinen, K. 2018. "Exploiting and Defending Open Digital Platforms with Boundary Resources: Android's Five Platform Forks," *Information Systems Research* (29:2), pp. 253-523.
- Krishnan, M. S., Kriebel, C. H., Kekre, S., and Mukhopadhyay, T. 2000. "An Empirical Analysis of Productivity and Quality in Software Products," *Management Science* (46:6), pp. 745-759.
- Lee, A. S., and Baskerville, R. L. 2003. "Generalizing Generalizability in Information Systems Research," *Information Systems Research* (14:3), pp. 221-243.
- Lee, G., and Xia, W. 2010. "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility," *MIS Quarterly* (34:1), pp. 87-114.

Diverging and Converging of Partners in Platform Development

- Lehmann, J., Recker, J., Yoo, Y., and Rosenkranz, C. 2022. "Designing Digital Market Offerings: How Digital Ventures Navigate the Tension between Generative Digital Technology and the Current Environment," *MIS Quarterly* (In-Press).
- Mithas, S., and Kude, T. 2017. "Digitization and Disciplined Autonomy," *IEEE IT Professional* (19:5), pp. 4-10.
- Moehlmann, M., Zalmanson, L., Henfridsson, O., and Gregory, R. W. 2021. "Algorithmic Management of Work on Online Labor Platforms: When Matching Meets Control," *MIS Quarterly* (45:4), pp. 1999-2022.
- Murthy, R. K., and Madhok, A. 2021. "Overcoming the Early-Stage Conundrum of Digital Platform Ecosystem Emergence: A Problem-Solving Perspective," *Journal of Management Studies* (58:7), pp. 1899-1932.
- Qiu, Y., Gopal, A., and Hann, I.-H. 2017. "Logic Pluralism in Mobile Platform Ecosystems: A Study of Indie App Developers on the Ios App Store," *Information Systems Research* (28:2), pp. 225-249.
- Saarikko, T., Jonsson, K., and Burström, T. 2019. "Software Platform Establishment: Effectuation and Entrepreneurial Awareness," *Information Technology & People* (32:3), pp. 579-602.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., and Jinks, C. 2018. "Saturation in Qualitative Research: Exploring Its Conceptualization and Operationalization," *Quality & Quantity* (52:4), pp. 1893-1907.
- Shah, S. K. 2006. "Motivation, Governance, and the Viability of Hybrid Forms in Open Source Software Development," *Management Science* (52:7), pp. 1000-1014.
- Shi, X., Li, F., and Chumnumpan, P. 2021. "Platform Development: Emerging Insights from a Nascent Industry," *Journal of Management* (47:8), pp. 2037-2073.
- Shipilov, A., and Gawer, A. 2020. "Integrating Research on Interorganizational Networks and Ecosystems," *Academy of Management Annals* (14:1), pp. 92-121.
- Tan, B., Pan, S. L., Lu, X., and Huang, L. 2015. "The Role of Is Capabilities in the Development of Multi-Sided Platforms: The Digital Ecosystem Strategy of Alibaba.Com," *Journal of the Association of Information Systems* (16:4), pp. 248-280.
- Tiwana, A., Konsynski, B., and Bush, A. A. 2010. "Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics," *Information Systems Research* (21:4), pp. 675-687.
- Urquhart, C. 2013. *Grounded Theory for Qualitative Research*. Thousand Oaks, CA: SAGE Publications.
- Wareham, J., Fox, P. B., and Cano Giner, J. L. 2014. "Technology Ecosystem Governance," *Organization Science* (25:4), pp. 1195-1215.
- Yin, R. K. 2009. *Case Study Research and Applications: Design and Methods*. Thousand Oaks, CA: SAGE Publications.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. 2010. "The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research," *Information Systems Research* (21:4), pp. 724-735.

Essay 4: An Exploration of Governing via IT in Decentralized Autonomous Organizations

- Authors:** Tobias Mini, University of Passau, Germany
Eleunthia Wong Ellinger, Universitat Ramon Llull, Spain
Robert W. Gregory, University of Miami, USA
Thomas Widjaja, University of Passau, Germany
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Abstract

A decentralized autonomous organization (DAO) is a distinct form of platform meta-organization that heavily relies on smart contracts running on blockchains to govern a distributed network of autonomous actors, thereby continuing the shift toward governance via IT. Motivated by the fact that this shift toward governance via IT in DAOs challenges established assumptions in the literature on IT governance, we explore how DAOs are governed via IT. For this purpose, we applied techniques of grounded theory to build inductive theory by analyzing five cases of DAOs (Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO) based on white papers, blog entries, and newspaper articles. Our findings implicate that DAOs governed via IT synthesize autonomy and alignment through the mechanism of “establishing algorithmic organization.” At the same time, DAOs rely on a more pluralistic and decentralized form of algorithmic management through the mechanism of “taming algorithmic power.”

An Exploration of Governing via IT in Decentralized Autonomous Organizations

Completed Research Paper

Tobias Mini^{*1}

University of Passau
Chair of Business Information Systems
tobias.mini@uni-passau.de

Eleunthia Wong Ellinger*

Universitat Ramon Llull
La Salle Barcelona Campus
Department of Management and
Technology
eleunthia.ellinger@salle.url.edu

Robert W. Gregory

University of Miami
Miami Herbert Business School
rwgregory@miami.edu

Thomas Widjaja

University of Passau
Chair of Business Information Systems
thomas.widjaja@uni-passau.de

Abstract

A decentralized autonomous organization (DAO) is a distinct form of platform meta-organization that heavily relies on smart contracts running on blockchains to govern a distributed network of autonomous actors, thereby continuing the shift toward governance via IT. Motivated by the fact that this shift toward governance via IT in DAOs challenges established assumptions in the literature on IT governance, we explore how DAOs are governed via IT. For this purpose, we applied techniques of grounded theory to build inductive theory by analyzing five cases of DAOs (Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO) based on white papers, blog entries, and newspaper articles. Our findings implicate that DAOs governed via IT synthesize autonomy and alignment through the mechanism of “establishing algorithmic organization.” At the same time, DAOs rely on a more pluralistic and decentralized form of algorithmic management through the mechanism of “taming algorithmic power.”

Keywords: Governance via IT, Decentralized Autonomous Organization (DAO), Blockchain, Digital Platform, Meta-Organization, Algorithmic Management

Introduction

Decentralized autonomous organizations (DAOs) are globally distributed networks of actors who align around a common overall purpose governed with the help of blockchain infrastructures, the algorithms in the form of smart contracts that run on top of them, and a shared constitution or set of rules and processes for operating and changing the network (Beck et al. 2018; Chen et al. 2021; Lumineau et al. 2021; Murray et al. 2019; Risius and Spohrer 2017; Ziolkowski et al. 2020b). For example, MakerDAO is a DAO built on the Ethereum blockchain to automate lending and borrowing of cryptocurrencies without the need for traditional fund managers. It is made up of smart contracts that govern borrowing and lending, as well as two currencies, Dai and MKR, to regulate the value of loans. Shared rules and processes ensure that token holders can influence certain aspects of MakerDAO such as the stability fee, collateralization ratio, and emergency shutdowns. Indeed, DAOs are trending—an estimated 200,000 people are already participating

¹ *These authors contributed equally.

actively in DAOs, which due to tools offered by projects such as OpenLaw are becoming increasingly fast and easy to set up and are now also considered as a legal entity since July 2021 in the U.S. state of Wyoming extending the applicability of DAOs to for-profit purposes like tokenized art or music (Shin 2021). Proponents of DAOs highlight their transparency, fairness, inclusion, and incorruptibility due to the absence of bilateral agreements, the use of open-source software protocols, and a sophisticated incentive system based on the use of digital currencies in the form of tokens. Since DAOs are still a poorly understood phenomenon and multiple early instances of DAOs have failed (e.g., “TheDAO”) (Voshmgir 2020) it is important to understand the novel mechanisms that underly governance in DAOs (Beck et al. 2018).

Previous research highlights that DAOs enable distributed actors to interact and cooperate with each other based on shared rules encoded in software algorithms to facilitate automated steering and contract enforcement (Beck et al. 2018; Chen et al. 2021; De Filippi and Wright 2018; Lumineau et al. 2021). Governance in DAOs includes complex combinations of community-driven human and algorithmic mechanisms to ensure the alignment of autonomous actors with a shared purpose (Baird and Maruping 2021; Murray et al. 2020). While previous literature has started to shed light on these and other characteristics of DAOs, we still have little in-depth understanding of the functioning of governance in DAOs and the conditions under which DAOs provide a new form of decentralized platform meta-organizing (Gulati et al. 2012) and a viable alternative to classical command-and-control structures prevalent in most organizations that rely on bureaucratic governance mechanisms (Puranam et al. 2014). Thus, governance in DAOs is an important research topic, especially in the Information Systems discipline, because of the strong emphasis on governance *via* information technology (IT).

Examining governance *via* IT in DAOs is important because decentralization makes it necessary to institute alternative IT-enabled governance structures that do not rely on traditional human-centric and resource-intensive mechanisms since they are often not scalable and suitable for decentralized organizing contexts. To better understand the characteristics of governance *via* IT, previous IT governance research in the context of digital transformation has started to shed light on the shift from governance *of* IT toward governance *via* IT through platform-based and technology-enabled mechanisms for governance (Gregory et al. 2018). This shift toward governance *via* IT underlying the DAO phenomenon challenges established assumptions (Alvesson and Sandberg 2013) of traditional IT governance literature and instead assumes heavy reliance on governance *via* IT, decentralization of decision-making, and the transparent and automated enforcement of rules which motivates a fresh perspective on IT governance and a critical discussion of the unique mechanisms that underly governance in DAOs (Beck et al. 2018).

In this paper, we take the perspective of blockchain governance (e.g., Beck et al. 2018; Chen et al. 2021; Lumineau et al. 2021; Murray et al. 2019; Ziolkowski et al. 2020b) and draw on the lens of governance *via* IT offered by the literature on digital platforms (e.g., Gregory et al. 2018; Moehlmann et al. 2021; Tiwana et al. 2010) which allows us to address the following research question: *How are decentralized autonomous organizations governed via IT?* For this purpose, we analyze five representative cases of DAOs (Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO) using techniques of grounded theory (Birks et al. 2013; Charmaz 2006; Gioia et al. 2013; Glaser and Strauss 1967; Walsh et al. 2015). Our core finding is that governing DAOs *via* IT requires two mechanisms called “establishing algorithmic organization” and “taming algorithmic power.” The first mechanism, “establishing algorithmic organization,” refers to the reinforcement of the software protocol’s central authority in the DAO through ongoing execution of routines. The second mechanism, “taming algorithmic power,” describes how humans both systematically and spontaneously perform actions to bend automated processes in the DAO to comply with their organizational will. Our findings implicate that DAOs governed *via* IT synthesize autonomy and alignment through “establishing algorithmic organization.” At the same time, governance *of* IT in DAOs involves a more pluralistic and decentralized form of algorithmic management through “taming algorithmic power.”

Conceptual Background

Decentralized Autonomous Organizations

Decentralized autonomous organizations (DAOs) gained widespread attention through increased blockchain development activity around the globe. A blockchain refers to a distributed database that can record transactions between actors in a peer-to-peer (P2P) network drawing on consensus algorithms for verification (Beck et al. 2018; Lumineau et al. 2021; Murray et al. 2019; Nakamoto 2008). The first

blockchain was outlined 2008 in a white paper by Satoshi Nakamoto, a pseudonymous person or group, and was called 'Bitcoin' describing the vision of a P2P payment system where online payments could be sent directly to each other without the need for a central financial institution that controls payment processing, i.e., in a fully decentralized way (Nakamoto 2008). Decentralization refers to the transfer of control and decision-making from a centralized entity, i.e., an organization, government, or company, to a distributed network (Chen et al. 2021). While not an entirely new phenomenon, decentralization has significantly gained new momentum in the context of blockchains (Cennamo et al. 2020). Decentralization in this blockchain space is driven to a large extent by the narrative that the current platform economy with its tendency toward surveillance, dominance, and centralized control over peoples' lives and perceived freedom lacks the degrees of fairness, protection of individual rights, transparency, and inclusion that digitally empowered citizens demand in the emerging token economy (Voshmgir 2020; Zuboff 2015). With Bitcoin's launch in early 2009 and subsequent growth toward becoming an accepted payment system, programmers began to explore the blockchain technology for uses outside of just digital currencies (Andersen and Bogusz 2019; De Filippi and Wright 2018; Lindman et al. 2017). Perhaps the most significant generalization over purely financial-oriented blockchains such as Bitcoin was envisioned 2014 in a white paper by Vitalik Buterin who introduced the Ethereum blockchain with the key idea of deploying so-called "smart contracts" on a blockchain (Buterin 2014b). Smart contracts refer to software programs that run on a blockchain and automatically execute preprogrammed rules and logic (Buterin 2014b; Szabo 1997).

In the same Ethereum white paper, Vitalik Buterin outlined the idea of using smart contracts to encode the bylaws of entire organizations, so-called 'Decentralized Autonomous Organizations' (DAOs) (Buterin 2014b). Vitalik Buterin characterized DAOs as having "automation at the center [and] humans at the edges" of the organization (Buterin 2014a). A DAO involves a distributed network of autonomous human or organizational actors who align around a common overall purpose with the help of blockchain infrastructures, the algorithms in the form of smart contracts that run on top of them, and a shared constitution or set of rules and processes for operating and changing the network (Beck et al. 2018; Buterin 2014a; De Filippi and Wright 2018; Murray et al. 2019; Voshmgir 2020).

The definition of DAOs above suggests that DAOs represent a distinct form of platform meta-organization (Gulati et al. 2012; Puranam et al. 2014) as members of a DAO are distributed and decentralized and make key decisions through voting on proposals such as how the rules and logic should be encoded in the smart contracts and finding agreement via majority consensus (Hsieh et al. 2018; Lumineau et al. 2021; Vergne 2020) which sets DAOs apart from most sharing economy platforms (e.g., Uber, Airbnb) where members are governed by powerful and centralized platform organizations (Kenney and Zysman 2016; Reischauer and Mair 2018). Members of a DAO are also (in part) their owners as they decide how the DAO should allocate its funds that represent the internal capital in the form of digital tokens that can represent anything from a store of economic value to a set of permissions in the physical or digital world and can be used to reward certain activities in a DAO (Buterin 2014a; Oliveira et al. 2018; Voshmgir 2020). Having internal capital sets DAOs apart from most decentralized online communities (e.g., Reddit, Wikipedia) or open-source projects (e.g., Debian) that often use reputation or status to reward contributions of its members (Aaltonen and Lanzara 2015; O'Mahony and Ferraro 2007). Potential contributors or investors in a DAO can exchange other digital cryptocurrencies or tokens for the DAOs native tokens to gain a stake in a DAOs internal capital (Buterin 2014a; De Filippi and Wright 2018). In accordance with the stake that the actors in the distributed network hold on a DAO, voting rights to participate in decision making are issued (Voshmgir 2020). DAOs heavily rely on smart contracts and the blockchain to automatically enforce the voting decisions by the members of a DAO and to transparently store transactions to align their interests and activities toward a shared purpose (Beck et al. 2018; Lumineau et al. 2021; Voshmgir 2020).

IT Governance in the Era of Blockchains and DAOs

The phenomenon of decentralized autonomous organizations summarized above provides the conceptual background for the shift toward blockchain-based governance *via* IT which is embedded in the historic evolution of IT governance. IT governance refers to the IT-related decision rights and accountability framework used to ensure the alignment of actors with the organization's overall purpose (Sambamurthy and Zmud 1999; Tiwana and Kim 2015; Wu et al. 2015). While the term IT governance became prominent in the late 1990s (Sambamurthy and Zmud 1999), earlier studies already focused on organizational IT-assets (e.g., mainframes) to which only individuals with specialized technical skills had rights to access and operate and who later formed the first IT functions (Niederman et al. 2016). In the 1970s to the early 1990s

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the focus of IT governance broadened significantly and included also more lightweight personal computers which increased the autonomy of end-users but also the coordination effort for IT professionals in the IT functions (Bygstad 2017; Niederman et al. 2016; Urbach et al. 2019). In the 1990s to the early 2000s enterprise resource planning systems and cross-organizational information systems (e.g., e-commerce applications) broadened the focus of IT governance again. Yet, the key responsibility of the IT function to provide user support for IT-related activities as well as the design, development, and maintenance of IT remained, which can be summarized as functional governance of IT (Drnevich and Croson 2013).

With the emergence of digital technology-enabled meta-organizations (Gulati et al. 2012) such as online communities (O'Mahony and Ferraro 2007) or digital platform ecosystems (Gregory et al. 2018; Huber et al. 2017; Tiwana et al. 2010; Tiwana et al. 2013; Wareham et al. 2014), IT governance began to span organizational boundaries. Building on digital infrastructures (Fuerstenau et al. 2019; Tilson et al. 2010) such as the Internet and guided by the 'code is law' principle from the open source movement (Lessig 2006), these online communities and digital platform ecosystems experimented with new mechanisms for IT governance using the code of their platforms to define rules that shape how people can act and interact online while also involving the community in governance (e.g., Aaltonen and Lanzara 2015; Gregory et al. 2018; Huber et al. 2017; O'Mahony and Ferraro 2007; Tiwana et al. 2010; Wareham et al. 2014). Governance in these technology-enabled meta-organizations is characterized by balancing alignment desired by the platform owner with autonomy of users or complementors in the surrounding ecosystem (Gulati et al. 2012). Centralized platform owners and their software engineers often develop and maintain standardized boundary resources or algorithms to govern their community in the ecosystem (Ghazawneh and Henfridsson 2013; Moehlmann et al. 2021; Tiwana et al. 2010). Using algorithms to govern the behavior of individual actors and to ensure their alignment to the meta-organization's purpose can be summarized as governance *via* IT (Drnevich and Croson 2013; Gregory et al. 2018; Moehlmann et al. 2021).

Blockchains and DAOs continue this shift toward governance *via* IT while allowing the whole community to actively shape the algorithms by which they are governed in a decentralized way. Governance of DAOs includes a collection of mechanisms to ensure the alignment of autonomous human actors toward the common overall purpose of a DAO (Beck et al. 2018; Chen et al. 2021; Lumineau et al. 2021; Murray et al. 2019). The governance structure that enables the community of human actors to interact and cooperate with each other is represented by rules that are encoded to empower network participants and administered by algorithms for automated steering and contract enforcement (Beck et al. 2018; Chen et al. 2021; De Filippi and Wright 2018; Lumineau et al. 2021). Especially three characteristics of blockchain-based governance challenge established assumptions (Alvesson and Sandberg 2013) of IT governance research.

First, DAOs heavily rely on governance *via* IT which includes mechanisms that rely on a set of sophisticated automated algorithms often encoded in smart contracts running on blockchains for governance of a distributed network of autonomous actors (De Filippi and Wright 2018; Lumineau et al. 2021; Murray et al. 2019). In the context of blockchains and DAOs, "IT solutions serve as a governance mechanism in their own right" (Lumineau et al. 2021, p. 507) where preprogrammed and automated smart contracts enforce decisions. This heavy reliance on governance *via* IT challenges the underlying assumption of the classical IT governance literature where decision-making, monitoring, and coordination are largely performed by human actors such as IT managers of an organization (e.g., Tiwana and Kim 2015; Wu et al. 2015).

Second, decentralization empowers actors in the distributed network of a DAO (e.g., developers or token holders) to modify the rules encoded in the automated smart contract code and to actively participate in governance decisions (e.g., via voting on proposals) (Beck et al. 2018; Chen et al. 2021; De Filippi and Wright 2018; Ziolkowski et al. 2020a; Ziolkowski et al. 2020b). By transferring previously centralized decision making to the community (Beck et al. 2018; Murray et al. 2019), decentralized governance in DAOs fundamentally challenges the assumption of the IT governance literature in which the design, development, and maintenance of IT systems is the primary responsibility of the IT function (e.g., Tiwana and Kim 2015; Wu et al. 2015) or of centralized platform owners and their software engineers (Tiwana et al. 2010).

Third, the enforcement of rules in DAOs is transparent, non-discriminatory, and automated by drawing on public smart contracts that are auditable and verifiable by almost anyone in the distributed network (Lumineau et al. 2021). This automated and public rule enforcement in blockchains and DAOs challenges the assumption held in the IT governance literature where rules are often described as being "latent" or invisible (de Vaujany et al. 2018) and architecture is often used as a form of non-overt control (Tiwana et al. 2013). These three refined assumptions invite an investigation of how DAOs are governed *via* IT.

Research Methodology

Theoretical Sampling and Data Collection

We adopted a theoretical sampling strategy (Charmaz 2006) to iteratively select cases for a multiple-case study (Yin 2009) of DAOs to explain how DAOs are governed *via* IT. As theoretical sampling assumes that grounded theoretical insights emerging from data can guide subsequent data collection and analysis (Glaser and Strauss 1967), we first collected an initial sample of 20 DAO cases that were mentioned in public blogs (e.g., on Medium.com and Twitter.com) and podcasts or videos on YouTube.com. This initial sample included MakerDAO, Flare Networks, Aragon, DigixDAO, TheDAO, Polkadot/PolkaDAO, MolochDAO, MetaCartel Ventures, OceanDAO, DarkDAO, The LAO, KyberDAO, SpiderDAO, Steem, SingularityDAO, Algorand, Colony, Tezos, Cardano/Project Catalyst, and CurveDAO. From there, we filtered these cases to maximize variation between DAO cases and allow for patterns to emerge more easily from constant comparisons across a manageable subset of DAOs (Glaser and Strauss 1967). To maximize variation within our dataset, we paid special attention to cases that fall on an extreme end of a spectrum of different DAOs (Gerring 2006). For example, we considered MolochDAO as an extreme case because its governance structure serves as a blueprint for other DAOs (e.g., MetaCartel or “The LAO”). We also considered extremely unsuccessful and successful cases of DAOs (e.g., TheDAO and MakerDAO). Our final sample included the following five cases of DAOs: Aragon, Flare Networks, KyberDAO, MakerDAO, and MolochDAO. We chose these DAOs based on their relative maturity, complexity, and prominent status in the DAO community, reasoning that their inner workings would be well-formed and theoretically most interesting.

Our primary case material consisted of secondary data including white papers, blog entries, and newspaper articles since this material provides rich and holistic descriptions of real DAOs, often dives deeper into technological underpinnings of DAOs, and hears different people’s voices (e.g., founders, developers of the technology, or token holders). For each DAO case in our sample we first collected one or more published white papers which are documents that detail technical, organizational, and economic specifications of a DAO and are often published for fundraising purposes before an initial coin offering (Voshmgir 2020). For each DAO case, we then also collected blog entries that inform about the current status of a DAO and are often written by the founders themselves and newspaper articles that provide additional information from the perspective of external observers. Overall, we collected and analyzed 257 pages of case material. To triangulate emerging findings, we concurrently also listened to podcasts, where influential people (e.g., founders) in the DAO space discussed recent developments and their motivation for participating in DAOs.

Data Analysis and Approach to Conceptualization

We used techniques of grounded theory (Birks et al. 2013; Charmaz 2006; Gioia et al. 2013; Glaser and Strauss 1967; Walsh et al. 2015) to iteratively build inductive theory. We performed open coding (Glaser and Strauss 1967) on each of the cases from the sample using the coding software MAXQDA, which led to an initial coding book consisting of first-order categories that remained close to our data (Gioia et al. 2013). Labels for these first-order categories were inspired by the structure of theoretical mechanisms (cf. Henfridsson and Bygstad 2013). Exemplary first-order categories were “fine-grained customization for who can perform an action” or “stakeholders vote on tokenomic parameters and listings.” Following open coding, as the second step we identified relationships emerging between first-order categories to organize them into second-order themes (Gioia et al. 2013). For example, the two first-order categories mentioned above led to the second-order theme “granularizing empowerment.” In the third step, all members of the author team regularly discussed the results and challenges of the coding, interrogating each other’s interpretations, and proposing alternative explanations which resulted in refined first-order categories, second-order themes, and conceptualizations of the final mechanisms (Gioia et al. 2013). For instance, over time we assessed that the second-order themes of “granularizing empowerment,” “triggering reactive interventions,” and “negotiating limits of automation” were closely related to humans who perform actions to bend automated processes in a DAO yet distinct from each other and bundled them into the mechanism of “taming algorithmic power.” The iterative coding and theoretical development stopped when we achieved a reliable and valid treatment of the mechanisms across the cases. This theoretical saturation (Charmaz 2006; Glaser and Strauss 1967; Saunders et al. 2018) was visible when the number of new first-order categories emerging from each additional case material decreased and no new second-order themes or mechanisms emerged from the data.

Findings

In this section, we delineate the key mechanisms that underly governance in DAOs, “establishing algorithmic organization” and “taming algorithmic power,” inductively theorized from the data of our DAO sample, along with their definitions and key themes as illustrated in Table 1.

Mechanism	Definition	Themes
Establishing Algorithmic Organization	The mechanism by which the software protocol reinforces its central authority in the DAO through ongoing execution of routines.	<ul style="list-style-type: none"> • Enforcing precise rules and steps: DAO core code executes consistent, substantive processes independently. • Encoding trust in the system: Technology creates radical transparency that DAO users trust as accurate and up-to-date. • Surveying the stakeholders and environment: Algorithms constantly monitor all agents and conditions to protect the integrity of the organization.
Taming Algorithmic Power	The mechanism by which humans both systematically and spontaneously perform actions to bend automated processes in the DAO to comply with their organizational will.	<ul style="list-style-type: none"> • Granularizing empowerment: The organization provides opportunities for holders to express their power through deciding on fine-grained parameters. • Triggering reactive interventions: The technology serves up relevant information for humans to use to conduct course correction. • Negotiating limits of automation: Humans customize components to alter the default direction set by the technology.

Table 1. Two Key Mechanisms That Underly Governance in DAOs

Establishing Algorithmic Organization

The mechanism of “establishing algorithmic organization” describes how algorithms drive foundational activities of a DAO and imprint their automation into baseline processes of the organization. In this section, we name and elaborate three key themes of this mechanism (see Figure 1 for an overview of the key concepts and relationships) and provide illustrative examples from DAOs.

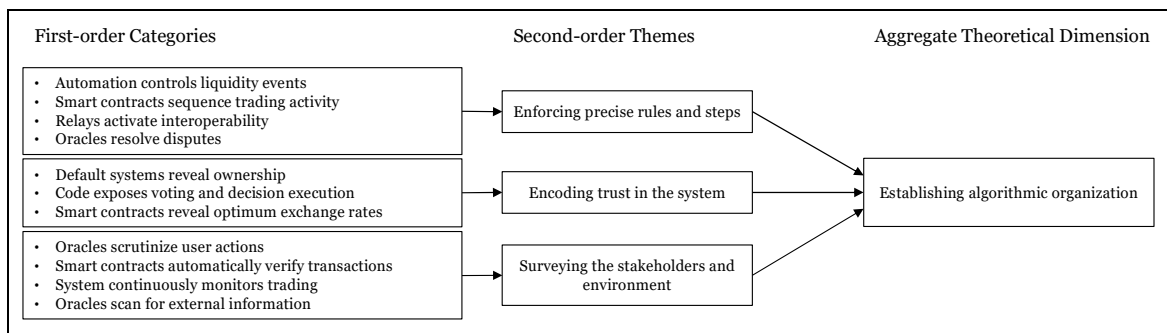


Figure 1. Mechanism of Establishing Algorithmic Organization

Enforcing precise rules and steps. First, exerting automated control over events regarding the internal capital is a core function in DAOs due to the functionality available in their core code. For instance, MakerDAO has created an automated protocol that without permission takes a series of steps to independently manage the liquidity of the internal capital for the DAO in multiple scenarios:

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“To ensure there is always enough collateral in the Maker Protocol to cover the value of all outstanding debt (the amount of Dai² outstanding valued at the Target Price), any Maker Vault deemed too risky (according to parameters established by Maker Governance) is liquidated through automated Maker Protocol auctions. Once the Surplus Auction has ended, the Maker Protocol autonomously destroys the MKR³ collected, thereby reducing the total MKR supply. During a Debt Auction, MKR is minted by the system (increasing the amount of MKR in circulation), and then sold to bidders for Dai” (MakerDAO 2017, p. 8).

Second, smart contracts are often employed to sequence and bundle trading activity in DAOs. For example, KyberDAO provides an algorithm to handle trades:

“A taker is an entity that takes the liquidity provided by the registered reserves by calling the trade() function in the Protocol Smart Contracts to trade from one token to another token....Takers do not have to wait for their orders to be fulfilled, since trade matching and settlement occurs in a single blockchain transaction. This enables trades to be part of a series of actions happening in a single smart contract function” (Kyber Network 2019, p. 7).

KyberDAO also enables “trustless and atomic token trades” that can be “directly and easily integrated into other smart contracts, thereby enabling multiple trades to be performed in a smart contract function” (Kyber Network 2019, p. 4). In addition, with Kyber Core smart contracts, actors are allowed to join and interact with the network. All these functions give control over significant trading activities to the codebase.

Third, DAOs set up relays that activate interoperability for the organization. KyberDAO achieves interoperability by implementing “a bi-directional relay of block headers between two blockchains” (Kyber Network 2019, p. 13). Relays at KyberDAO have been established to connect different blockchain systems:

“For smart contract-enabled chains, the most practical interoperability implementation is to have a light client as a smart contract which can be implemented on both blockchains and an efficient algorithm to verify the hash functions from both blockchains with minimal computation costs can be used. In our Waterloo project, we presented a proof of concept to prove the feasibility of a practical relay approach between Ethereum and EOS. We also demonstrated a similar approach in the PeaceRelay project to connect between Ethereum and Ethereum Classic” (Kyber Network 2019, p. 13).

In this case, interoperability between blockchains increases the DAO network and is being operated within the codebase in a permissionless, unstoppable manner.

Fourth, non-human oracles which are data feeds that provide information about the outside world to the blockchain operate independently in some DAOs to resolve disputes between human agents. Aragon has established a “decentralized oracle protocol,” referred to as a Court, to settle disputes regarding proposals:

“The Aragon Court is a decentralized oracle protocol developed and maintained by the Aragon Network. The Aragon Court can be used by organizations, including the Aragon Network itself, to resolve subjective disputes with binary outcomes” (Aragon 2020b).

The ability of software to intervene and decide the outcome of human disputes seems to be a novel feature of the Aragon DAO. Similar approaches exist in MolochDAO where members can ‘ragequit’ from the DAO and withdraw their funds which is enforced by restricting ‘ragequitting’ to only members who voted ‘no’ on a proposal (Soleimani et al. 2019), or the Flare DAO where different voting decisions need to conform to different requirements (e.g., simple majority, super majority, or super super majority) (Flare Networks 2020). In total, automation controls liquidity and trading activity (as in MakerDAO), interoperability (as in KyberDAO), and even human dispute resolution arising through contentious voting decisions (as in Aragon, MolochDAO, and Flare), all of which are administered by algorithms that enforce precise rules and steps.

Encoding trust in the system. A typical DAO provides significant transparency in its systems, which creates trust in the organization amongst its holders. First, by default, DAO systems reveal ownership, with extended descriptions of this ownership such as holdings or reward allocations. One example is Aragon:

² Dai is the label for the cryptocurrency used in MakerDAO.

³ MKR denotes the governance token in MakerDAO, i.e., the token that grants voting rights.

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“Ownership in an Aragon Core organization is transparent and transferable. Each stakeholder’s holdings are public, and a stakeholder has the right to transfer ownership to another party. There are four transparent functions of ownership built into Aragon Core.

These are: - List all stakeholders (and their holdings) - Issue shares, arbitrarily or with parameters - Sell or transfer tokens - Issue new tokens” (Cuende and Izquierdo 2017, p. 11).

As another example, KyberDAO’s system records all its rewards due to its individual members on-chain, providing full transparency into distributions.

Second, typical DAO core code exposes voting and decision execution in the organization. Such transparency reveals intimate organizational details that make it possible for members to have data access to virtually everything about their organization. In one example:

“The KyberDAO and governance process was designed to empower our community with fair representation on topics that are meaningful to them, ensure maximum viable transparency on voting and post-vote execution, while ensuring the security and stability of Kyber Network” (Kyber Network 2020).

With such minute yet critical details of organizational activity being exposed by the core code of DAOs, trust in the system of the DAO by its members should inherently increase.

Third, by nature of their configuration, smart contracts in DAOs can reveal optimum exchange rates. For instance, in KyberDAO, *“the protocol smart contracts offer a single interface for the best available token exchange rates to be taken from an aggregated liquidity pool across diverse sources”* (Kyber Network 2019, p. 4). When the best available rates are provided by protocol smart contracts, holders can trust that they can act on this information from a fair and completely automated source.

As the cases of Aragon and KyberDAO show, DAOs typically reveal fundamental details such as ownership, voting, and voting execution in their default configurations which is also featured in MolochDAO where membership proposals are hashed and stored for record-keeping (Soleimani et al. 2019). Through smart contracts, they provide undisputable and up-to-date information such as optimum exchange rates to all holders which is also salient in the Flare DAO where oracle data feeds provide accurate price information to incentivize shareholders to act honestly or in MakerDAO where keeper algorithms step in when the system is at risk to stabilize the DAO, which will reinforce the trust that members have in the DAO. In sum, through these software functions, DAOs encode trust in their systems. The trust that members place in the DAOs, based on algorithmic structure, reinforce participation and investment in organizational activities.

Surveying the stakeholders and environment. While DAOs are based on software systems in which its members place their trust, the software systems, in turn, are constantly monitoring its stakeholders and environment. First, oracles scrutinize stakeholder actions in exhaustive detail. According to the Flare DAO, *“the core feature of an oracle should be a decentralized data feed exploiting the distributed nature of the underlying system whilst incentivizing players to be honest”* (Flare Networks 2020, p. 9). The Flare Time Series Oracle provides data feeds to monitor two types of holders to a close degree, in relation to each other:

“The Flare Time Series Oracle...provides a periodic on-chain estimate of the current value of any number of off-chain time series. The contributors to a specific time series consists at a minimum of Spark token holders but will under certain circumstances include the token holders of an application that relies on that time series, called F-asset holders.

The Flare Time Series Oracle (FTSO) has a reward function which generates new Spark tokens⁴. The new Spark tokens are used to reward Spark holding contributors.

Each oracle estimate is determined by two groups with competing interests: holders of Spark, and holders of the F-asset tokens issued in relation to the relevant data estimate.

The time series oracle provides the on-chain XRP⁵/Spark price, based on the estimates being submitted by both holders of Spark and FXRP. By virtue of holding either FXRP or Spark, both

⁴ Spark tokens refer to the native tokens of the Flare DAO.

⁵ XRP refers to the cryptocurrency used by the Ripple blockchain settlement system.

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these groups have an implicit stake in the system i.e. an incentive to act honestly, as accurate pricing maintains the systems integrity and utility” (Flare Networks 2020, pp. 7-10).

This automated monitoring scrutinizes user actions as a protective measure for DAO stability.

Second, smart contracts can also be used in DAOs to verify operations. For example, in KyberDAO, specific operations, such as token transfers, are automatically verified through smart contracts.

Third, algorithms in DAOs continuously monitor and execute trading. According to KyberDAO, public rate verification is a core functionality: “Anyone can verify the rates that are being offered by reserves and have their trades instantly settled just by querying from the smart contracts” (Kyber Network 2019, p. 4). Monitoring of trades is an additional way where the environment is regularly surveyed algorithmically.

Fourth, automated systems in DAOs monitor the environment, often through oracles. According to MakerDAO: “The Protocol derives its internal collateral prices from a decentralized Oracle infrastructure that consists of a broad set of individual nodes called Oracle Feeds” (MakerDAO 2017, p. 11). Through such software devices, oracles scan for external information without involvement or direction from humans.

DAOs can constantly monitor virtually any activity within or outside of the organization to protect organizational interests. Some oracles scrutinize stakeholder actions (as in the Flare DAO) while others scan for external information (as in MakerDAO). Smart contracts can verify operations and monitor trading (as in KyberDAO). This monitoring is created and maintained on the level of core software but could also be complemented by a partly automated bug bounty mechanism that raises human investigation if weird behavior or an unexpected state is detected as in the case of Aragon (Cuende and Izquierdo 2017) or to raise ‘kick proposals’ to jail malicious members as in the case of MolochDAO (MolochDAO 2020). In these ways, DAOs exert substantial abilities to survey their stakeholders and environments.

In the summary view of the mechanism, first, DAOs set up software systems to enforce precise rules and steps in the organization. The code of a DAO executes consistent, substantive processes independently. Second, through a series of default configurations, DAOs encode trust in their systems on the part of their members. Technology creates radical transparency that DAO users trust as accurate and up-to-date. Third, DAOs conduct ongoing surveying of their users and their environments through non-human oracles and smart contracts. Algorithms constantly monitor all agents and conditions to protect the integrity of the organization. Taken as a whole, such enforcement, encoding, and surveying establishes and institutes an algorithmic organization in a DAO. In the mechanism of “establishing algorithmic organization,” software is the basis of the DAO and reinforces its central authority through its ongoing execution of routines.

Taming Algorithmic Power

While the first identified mechanism described above places software at the forefront of core DAO function, additional data analysis surfaced a second mechanism that counters this software dominance. The mechanism of “taming algorithmic power” describes ongoing human interventions within a DAO that harness and direct the power of the software systems and is based upon the processes by which human authority shapes outcomes of a DAO. This section describes the second-order themes of this mechanism (see Figure 2 for an overview of the key concepts and relationships) and includes supporting data.

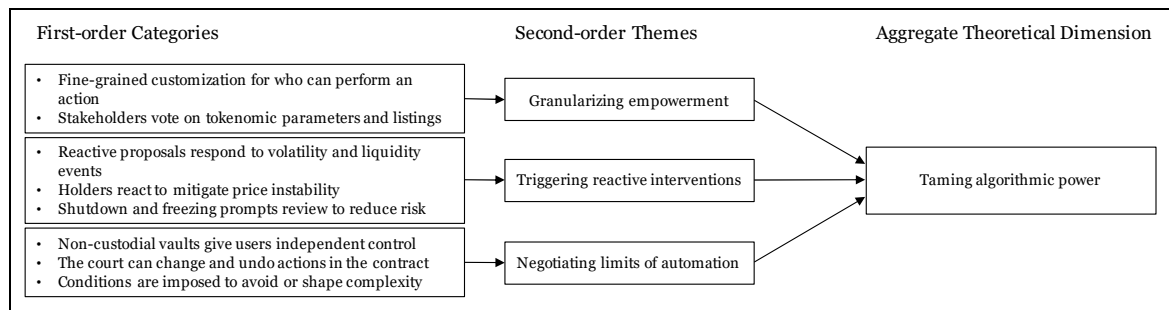


Figure 2. Mechanism of Taming Algorithmic Power

Granularizing empowerment. First, DAOs often provide fine-grained customization for who can perform a particular action in the organization. This customization facilitates human decision making on a wide variety of organizational activities by reducing decision complexity. As one example:

“Aragon organizations have customizable bylaws that allow for fine-grain customization into who can perform an action (ie, an executive can add an employee to the payroll) or what needs to happen (ie, a voting needs to be approved to issue tokens) before the action is allowed” (Cuende and Izquierdo 2017, p. 10).

Second, stakeholders vote on automatable parameters and listings encoded in the smart contracts that substantially impact the way their DAO functions. KyberDAO delineates *“a host of tokenomic parameters, upgrade decisions, token listings, which KNC⁶ stakeholders will in turn be able to vote and decide on”* (Kyber Network 2019, p. 17) for individual implementations on its blockchain.

As much as the DAO directs and monitors human action, it also provides code-based modular approaches enabling users to act autonomously (as in the cases of Aragon and KyberDAO) which is also salient in MakerDAO where the community is responsible for voting on encoded parameters to configure smart contracts to find an optimal balance between token supply and demand (MakerDAO 2017) and the Flare DAO where stakeholders vote on internal parameters but also on external oracles (Flare Networks 2020). In addition, existing members in MolochDAO can vote for the software code to admit new members or kick existing members (MolochDAO 2020; Soleimani et al. 2019). Granularizing human empowerment in the DAO enhances and extends the degree to which humans can shape their engagement in the organization, since increasing opportunities to make decisions on multiple levels typically leads to more impact.

Triggering reactive interventions. First, some DAOs have algorithms that alert holders to certain conditions (e.g., volatility or liquidity events) providing an opportunity for any holder to respond by making a proposal to the community. For instance, MakerDAO has defined a process called *“the reactive proposal”*:

“Collateral types included in the system may have changed in terms of liquidity and thus may require an alteration to their specific debt ceiling. Volatility may have moved to a different regime for a collateral type or for crypto as a whole and the liquidity ratio may need to be changed. Basically, reactive proposals respond to changes in the system” (MakerDAO 2018).

Second, oracles provide a way in DAOs to make holders aware of risky financial situations, and holders then have the option to react to mitigate price instability. For MakerDAO, the holders of the governance token MKR are granted voting rights to ensure stability of Dai:

“MKR holders can mitigate the price instability by voting to modify the DSR⁷ accordingly:

- *If the market price of Dai is above 1 USD, MKR holders can choose to gradually decrease the DSR, which will reduce demand and should reduce the market price of Dai toward the 1 USD Target Price.*
- *If the market price of Dai is below 1 USD, MKR holders can choose to gradually increase the DSR, which will stimulate demand and should increase the market price of Dai toward the 1 USD Target Price”* (MakerDAO 2017, p. 12).

The transparency encoded in the DAO software brings data automatically to the members, who can then opt to act based on this information.

Third, some DAOs institute human-based mechanisms to guard against risk. In the case of Aragon, shutting down and freezing operations is initiated by a member and prompts human deliberation:

“In extreme cases, there may be cause to freeze operations of the organization. For example, when all stakeholder funds are at risk. Any organization shareholder can raise an issue where the company’s contracts are frozen and moved to a state of review” (Aragon 2020a).

Though DAO algorithms may operate in a permissionless and unstoppable state, beyond the realm of human agency, there are several scenarios in which DAO code functions as helpmates to human members.

⁶ KNC denotes the native token of KyberDAO.

⁷ DSR refers to the Dai Savings Rate and is the interest rate paid to deposits made by Dai holders.

The sophistication of its software allows DAOs to recognize emergency scenarios and to communicate it in a precise and timely manner to their community. This empowers the human actors to take control of the direction of a DAO by making reactive proposals and deciding on mitigations as in the case of MakerDAO or in extreme cases shutting down organizational operations entirely until a community review can be conducted as in the case of Aragon. Similarly, in KyberDAO certain events (e.g., token transfers to another blockchain) have to be approved by governance (Kyber Network 2019) while in the Flare DAO automated parameters have preset thresholds which trigger governance voting when reached (Flare Networks 2020) and in MolochDAO a dilution bound trigger prevents that more than 80% of members can ‘ragequit’ from the DAO (Soleimani et al. 2019). “Triggering reactive interventions” describes how non-human actors in a DAO support human actors in making proposals to the community to improve organizational function.

Negotiating limits of automation. First, DAOs often institute spaces in the organization that are largely autonomous. For instance, MakerDAO sets up non-custodial vaults that give users independent control:

“Vaults are inherently non-custodial: Users interact with Vaults and the Maker Protocol directly, and each user has complete and independent control over their deposited collateral as long the value of that collateral doesn’t fall below the required minimum level” (MakerDAO 2017, p. 7).

In the case of these non-custodial vaults, the default operation is independent, in other words, lack of intervention of the many algorithmic processes that usually run the DAO.

Second, DAOs often balance the automation of smart contracts with mediation based on human discernment. In Aragon, a court has been established that can change and undo actions in a smart contract:

“All organizations in the network agree to be bound to the ANJ⁸ decentralized court. This protects individual organization stakeholders from the pure objectivity of smart contracts, that makes it very difficult and unproductive to encode certain things” (Cuende and Izquierdo 2017, p. 36).

In this case, the DAO explicitly calls out the need at times to limit the function of smart contracts, because left to run alone, they may go in a direction that could be harmful to stakeholders. This tendency is balanced by a formally recognized court that interrupts the default action of the algorithm and resets its course.

Third, there is recognition in DAOs that basic blockchain technology, by itself, is not always beneficial to the organization. DAOs take various steps to mitigate the limits of technology such as imposing conditions to avoid or shape complexity. For instance, Flare explicitly restricts complexity in its organization:

“The EVM⁹ defines a transaction’s computational complexity in terms of units of Gas. To avoid extremely lengthy or interminable transactions, Flare imposes a complexity limit, defined in Gas units” (Flare Networks 2020, p. 6).

In a related example, Aragon recognizes that in some cases, imposing a structure onto contracts can be beneficial to optimize operations in the DAO:

“Some contracts are intended to forward actions based on pre-defined criteria, for example, a voting app will forward action after a successful approval vote. By chaining multiple contracts together we can define complex criteria which constrain how actions can be performed within the organization” (Aragon 2020b).

In these ways, whether it is by design or through specific intervention, human actors negotiate limits of automation. In the case of MakerDAO, components of a DAO, such as non-custodial vaults, are largely controlled by users. In others such as Aragon, a formal structure such as a court has been set up for human conflicts that exceed the abilities of smart contracts. Human actors also set policies to limit or shape the complexity by which smart contracts are executed as in the Flare DAO. Similarly, MolochDAO defines a dilution bound for the maximum dilution in value that the tokens of members can suffer while in KyberDAO members need to specify minimum or maximum values for transaction parameters when calling smart contract functions to trade tokens. Implicit in all of these processes is the acknowledgement that algorithms are limited in what they can accomplish, and sometimes there is no substitute for full human agency.

⁸ ANJ refers to the Aragon Network Jurisdiction token used in the Aragon Court.

⁹ The EVM refers to the Ethereum Virtual Machine and runs smart contracts on the Ethereum blockchain.

Summing up this second mechanism, first, DAOs granularize empowerment through fine-grained customization and voting on automatable parameters, thus expanding the powers of human agents in the organization. A DAO provides opportunities for holders to express their power through deciding on parameters and configuration. Second, DAO automatic monitoring and informing of unstable conditions triggers reactive interventions by its members, reinforcing their authority to make proposals to the community. The technology serves up relevant information for humans to use to conduct course correction. Third, DAOs institute policies where members are either granted full autonomy outside of the realm of the software protocol, or where the protocol may be shaped or overridden based fully on human initiative to optimize the organization. Humans customize components to alter the default direction set by the technology. Thus, in the mechanism of “taming algorithmic power,” humans both systematically and spontaneously perform actions to bend automated processes to comply with their organizational will.

Discussion

Implications for Research

The first significant implication of our study is for research on platform-based governance *via* IT in general (e.g., Ghazawneh and Henfridsson 2013; Gregory et al. 2018; Huber et al. 2017; Moehlmann et al. 2021; Tiwana et al. 2010; Wareham et al. 2014), and blockchain governance in particular (e.g., Beck et al. 2018; Chen et al. 2021; Lumineau et al. 2021; Murray et al. 2019; Risius and Spohrer 2017; Ziolkowski et al. 2020b). Our findings around the mechanism of “establishing algorithmic organization” extend and add more nuances to our emergent understanding of governance *via* IT in platform-based settings (e.g., Gregory et al. 2018). Platform-based governance not only relies on automated processes, which in centralized platform settings are oftentimes opaque to distributed users and can be bent by formal managers to re-align with their goals (de Vaujany et al. 2018; Tiwana et al. 2010). But, in DAOs we see such automation involving a process of “enforcing precise rules and steps” that helps resolve disputes and achieve co-functioning of dispersed parts of the network without having to rely on a centralized coordination mechanism such as the hierarchy (Beck et al. 2018; Lumineau et al. 2021). Even if prior literature has begun shifting the research focus from functional to platform-based governance mechanisms, including formal and informal control (Tiwana et al. 2010) or standardized rules (Ghazawneh and Henfridsson 2013; Wareham et al. 2014), the predominant focus on centralized platform settings has prevented scholars from explaining the shifting power dynamics and automated enforcement of rules accompanying the greater reliance on algorithmic processes in platform meta-organizations. In addition, our findings about “encoding trust in the system” shed new light on how transparent platform-based governance in DAOs acts as a microfoundation for facilitating peer-to-peer interactions and transactions, instead of relying on a single ‘trust-worthy’ platform owner that is in the middle of every transaction (Huber et al. 2017). As our findings highlight, revealing ownership of actors, exposing the use of their influence, and providing transparency more generally are all central components of “encoding trust in the system” which suggests a form of trust *in* algorithms (Ostern 2018; Risius and Spohrer 2017) complemented by a form of decentralized trust *through* algorithms. While autonomy and the voice of every individual actor are respected through this new form of governance *via* IT, our findings also suggest that “establishing algorithmic organization” involves the process of “surveying the stakeholders and environment,” which is a commonality across different forms of platform-based governance *via* IT, but does not necessarily have to be associated with centralized control by a platform owner (Moehlmann et al. 2021) when paired with transparency and trust as achieved through “establishing algorithmic organization.” These findings extend our understanding of a pattern that prior IT governance literature in platform-based settings has started to identify descriptively without offering a systematic explanation. In particular, as governance in decentralized platform settings such as DAOs relies on nonhierarchical mechanisms, a key challenge is synthesizing autonomy and alignment without relying on hierarchical control as in functional IT governance in traditional large organizations. While the process of “encoding trust in the system” increases autonomy of each member in a DAO, the process of “surveying the stakeholders and environment” complements that process by ensuring alignment and achieving dynamic equilibrium as the DAO continuously adapts to internal and external changes (e.g., changes in the composition of actors in the network or in economic data points). In sum, our findings about “establishing algorithmic organization” provide a systematic explanation of the patterns of DAO governance *via* IT.

The second significant implication for research is offered by the mechanism of “taming algorithmic power” identified in our study that extends the concept of algorithmic management itself (e.g., Faraj et al. 2018;

Kellogg et al. 2019; Moehlmann et al. 2021). Our findings about “taming algorithmic power” highlight that the more a DAO relies on algorithmic governance processes embedded into the design of the platform to achieve automation, efficiency, and scalability, the more the resulting mechanism underlying governance *via* IT must be complemented with a mechanism focused on governance *of* IT. When algorithms are relied on for coordination and governance in a DAO, the associated establishment of algorithmic organization as the new normal also requires several processes highlighted by our findings that contingently act as ‘checks and balances’ for algorithmic coordination and management. Extending previous research on algorithmic management (e.g., Moehlmann et al. 2021), we find that the process of “granularizing empowerment” ensures the ongoing influence of actors in the network to shape the functioning of algorithmic governance processes with their voice that they either use individually or collectively as part of their voting rights that come along with DAO token ownership. Thus, by “granularizing empowerment,” a more pluralistic form of algorithmic management becomes possible, highlighting the contributions to collective organizing in complex environments that stem from the inclusion of a diversity of different perspectives and voices (e.g., Brès et al. 2018; Denis et al. 2001), that contrasts with the Taylorist principles of scientific management that previous research shows get reinforced through algorithmic coordination and governance in centralized platform settings (Kellogg et al. 2019; Moehlmann et al. 2021). Expanding further on our key findings, the process of “triggering reactive interventions” helps explain how through community-driven sensemaking and initiatives to change the system, oftentimes triggered by the algorithms themselves, a DAO develops an adaptive sensory system to mitigate the risk of organizational failure under stability-threatening turbulences and events (e.g., volatility events in the face of market turbulences or major socio-technical breakdowns in the functioning of the network overall). In addition, while research in centralized platform settings found that data is used by the platform owner to power machine learning algorithms that control and nudge the behavior of humans (Moehlmann et al. 2021), “triggering reactive interventions” instead suggests that data and information is used in DAOs by community members to adapt the code of the very algorithms. “Taming algorithmic power” and ensuring that governance *via* IT is complemented by governance *of* IT in DAOs to ensure they are conducive to human ideals, goals, and desires for change and improvement is also facilitated by the process of “negotiating limits of automation” which seems to free members of a DAO from the ‘algorithmic iron cage’ (Faraj et al. 2018; Kellogg et al. 2019) and instead empowers them to customize components to alter the default direction set by the technology. In sum, our findings about “taming algorithmic power” highlight governance *of* IT in DAOs as dynamic, emergent, multidirectional, and granular.

Third and overall, our findings imply that both mechanisms, “establishing algorithmic organization” and “taming algorithmic power,” interact with each other, adding empirical depth and theoretical clarity to this conjoined agency between humans and algorithms that the literature has only recently started exploring (e.g., Baird and Maruping 2021; Cram and Wiener 2020; Murray et al. 2020; Raisch and Krakowski 2021; Rossi et al. 2019). Governance in DAOs involves combining governance *via* IT, through the mechanism of “establishing algorithmic organization,” with governance *of* IT, through the mechanism of “taming algorithmic power,” into a duality (Farjoun 2010). These findings point to a fundamental novel tension in blockchain governance that must be resolved for effective governance in DAOs, the tension between governance *via* IT and governance *of* IT. On the one hand, DAOs must rely on governance *via* IT to achieve maximum scalability for decentralized organizing and non-hierarchical control to maintain high autonomy and alignment of individual actors. On the other hand, governance *via* IT and the associated power of algorithms potentially also creates rigidities and limits the influence of actors to change and re-align the organization with new priorities and objectives to maintain its dynamic equilibrium. In a DAO, the one shared platform with its influential set of embedded algorithms that coordinate and govern interactions and transactions must coexist in a duality with the community of distributed actors in the network who ultimately need to support, change, and adapt the design of the decentralized platform to identify with the overall purpose of a DAO. In this regard, DAOs are similar to the way the individual and the collective group of individuals (i.e., the organization) have to coexist within a complementary duality for a humanistic and pluralistic organization to function. Without creating such a duality, DAOs cannot function, and they fall apart and fail as witnessed many times in the short history of DAOs. These findings relate to yet also extend previous research on the conjoined agency (Murray et al. 2020) between humans and agentic IS artifacts (Baird and Maruping 2021). While previous literature assumed that the algorithms themselves can be seen as actors and theorized the need for finding an appropriate delegation of tasks to and from humans and agentic IS artifacts as a centralized process of a designer (Baird and Maruping 2021), our findings highlight that in the context of DAOs this process involves complex negotiation between autonomous human and

algorithmic actors. In particular, we find that in the conjoined agency between human and algorithmic actors, smart contracts not only “arrest” humans by intentionally constraining them in routine activities (Murray et al. 2020), but rather facilitate collective action by autonomous human actors.

Implications for Practice

Our findings have implications for practitioners who need to understand governance in DAOs. First, how to make technological and human actors accountable and liable in DAOs is still an open regulatory question (De Filippi and Wright 2018; Treiblmaier et al. 2021). Our two mechanisms, “establishing algorithmic organization” and “taming algorithmic power,” along with their key themes can help to flesh out the legal requirements for both humans and technology in limited liability DAOs such as ‘The LAO’—that ties binding legal agreements to smart contracts. Second, historic failure cases like ‘TheDAO’—that heavily relied on governance *via* IT but famously failed due a programming error—question the sustainability of DAOs. Our findings regarding the mechanism of “taming algorithmic power” can help to increase the resilience of DAOs by quickly sensing and responding to endogenous or exogenous events (e.g., software hacks).

Limitations and Future Research

Opportunities for future research arise when considering the limitations of this study. First, while we systematically and carefully sampled the five DAO cases to ensure maximum variation and representativeness, these cases are still partly in development. Future research could study other DAO cases to further validate our two mechanisms. Second, while we advance the perspective of viewing governance *via* IT, through the mechanism of “establishing algorithmic organization,” and governance *of* IT, through the mechanism of “taming algorithmic power,” as a duality, we did not focus on the dynamic push and pulls between both poles of the tension over time. Future research may unveil the dynamic interplay and balancing act of governance *via* IT and governance *of* IT through the mechanisms of “establishing algorithmic organization” and “taming algorithmic power.” Last, we answered the questions of ‘how’ DAOs are governed *via* IT and by ‘what’ mechanisms. We identified two key mechanisms, “establishing algorithmic organization” and “taming algorithmic power.” However, we remained virtually silent about the underlying economic or social dynamics that justified ‘why’ DAOs rely on both “establishing algorithmic organization” and “taming algorithmic power” as mechanisms underlying governance (Whetten 1989).

Conclusion

DAOs continue the shift from governance *of* IT toward governance *via* IT by relying on algorithms to govern a distributed network of autonomous actors. Motivated by the fact that this shift challenges established assumptions in the literature on IT governance, we explored how DAOs are governed *via* IT. We found that DAOs governed *via* IT synthesize autonomy and alignment through the mechanism of “establishing algorithmic organization.” At the same time, governance *of* IT in DAOs involves a more pluralistic and decentralized form of algorithmic management through the mechanism of “taming algorithmic power.”

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References

- Aaltonen, A., and Lanzara, G. F. 2015. "Building Governance Capability in Online Social Production: Insights from Wikipedia," *Organization Studies* (36:12), pp. 1649-1673.
- Alvesson, M., and Sandberg, J. 2013. *Constructing Research Questions: Doing Interesting Research*. London: SAGE Publications.
- Andersen, J. V., and Bogusz, C. I. 2019. "Self-Organizing in Blockchain Infrastructures: Generativity through Shifting Objectives and Forking," *Journal of the Association for Information Systems* (20:9), pp. 1242-1273.
- Aragon. 2020a. "Aragon Network Jurisdiction Part 1: Decentralized Court." Retrieved March 23, 2021, from <https://blog.aragon.org/aragon-network-jurisdiction-part-1-decentralized-court-c8ab2a675e82/>

- Aragon. 2020b. "Aragon Network: An Opt-in Digital Jurisdiction for Daos and Sovereign Individuals." *White Paper* Retrieved March 23, 2021, from <https://github.com/aragon/whitepaper>
- Baird, A., and Maruping, L. M. 2021. "The Next Generation of Research on Is Use: A Theoretical Framework of Delegation to and from Agentic Is Artifacts," *MIS Quarterly* (45:1), pp. 315-341.
- Beck, R., Mueller-Bloch, C., and King, J. L. 2018. "Governance in the Blockchain Economy: A Framework and Research Agenda," *Journal of the Association for Information Systems* (19:10), pp. 1020-1034.
- Birks, D. F., Fernandez, W., Levina, N., and Nasirin, S. 2013. "Grounded Theory Method in Information Systems Research: Its Nature, Diversity and Opportunities," *European Journal of Information Systems* (22:1), pp. 1-8.
- Brès, L., Raufflet, E., and Boghossian, J. 2018. "Pluralism in Organizations: Learning from Unconventional Forms of Organizations," *International Journal of Management Reviews* (20:2), pp. 364-386.
- Buterin, V. 2014a. "Daos, Dacs, Das and More: An Incomplete Terminology Guide." Retrieved February 12, 2021, from <https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide/>
- Buterin, V. 2014b. "A Next-Generation Smart Contract and Decentralized Application Platform." *White Paper* Retrieved March 30, 2021, from <https://ethereum.org/en/whitepaper/>
- Bygstad, B. 2017. "Generative Innovation: A Comparison of Lightweight and Heavyweight It," *Journal of Information Technology* (32:2), pp. 180-193.
- Cennamo, C., Marchesi, C., and Meyer, T. 2020. "Two Sides of the Same Coin? Decentralized Versus Proprietary Blockchains and the Performance of Digital Currencies," *Academy of Management Discoveries* (6:3), pp. 382-405.
- Charmaz, C. 2006. *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*. London: SAGE Publications.
- Chen, Y., Pereira, I., and Patel, P. C. 2021. "Decentralized Governance of Digital Platforms," *Journal of Management* (47:5), pp. 1305-1337.
- Cram, W. A., and Wiener, M. 2020. "Technology-Mediated Control: Case Examples and Research Directions for the Future of Organizational Control," *Communications of the Association for Information Systems* (46), pp. 70-91.
- Cuende, L., and Izquierdo, J. 2017. "Aragon Network: A Decentralized Infrastructure for Value Exchange." *White Paper* Retrieved March 23, 2021, from <https://cryptorating.eu/whitepapers/Aragon/Aragon%20Whitepaper.pdf>
- De Filippi, P., and Wright, A. 2018. *Blockchain and the Law: The Rule of Code*. Cambridge, MA: Harvard University Press.
- de Vaujany, F.-X., Fomin, V. V., Haefliger, S., and Lyytinen, K. 2018. "Rules, Practices, and Information Technology: A Trifecta of Organizational Regulation," *Information Systems Research* (29:3), pp. 755-773.
- Denis, J.-L., Lamothe, L., and Langley, A. 2001. "The Dynamics of Collective Leadership and Strategic Change in Pluralistic Organizations," *Academy of Management Journal* (44:4), pp. 809-837.
- Drnevich, P. L., and Croson, D. C. 2013. "Information Technology and Business-Level Strategy: Toward an Integrated Theoretical Perspective," *MIS Quarterly* (37:2), pp. 483-510.
- Faraj, S., Pachidi, S., and Sayegh, K. 2018. "Working and Organizing in the Age of the Learning Algorithm," *Information and Organization* (28:1), pp. 62-70.
- Farjoun, M. 2010. "Beyond Dualism: Stability and Change as a Duality," *Academy of Management Review* (35:2), pp. 202-225.
- Flare Networks. 2020. "The Flare Network and Spark Token." *White Paper* Retrieved March 18, 2021, from <https://flare.xyz/whitepapers/>
- Fuerstenau, D., Baiyere, A., and Kliewer, N. 2019. "A Dynamic Model of Embeddedness in Digital Infrastructures," *Information Systems Research* (30:4), pp. 1319-1342.
- Gerring, J. 2006. *Case Study Research: Principles and Practices*. Cambridge: Cambridge University Press.
- Ghazawneh, A., and Henfridsson, O. 2013. "Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model," *Information Systems Journal* (23:2), pp. 173-192.
- Gioia, D. A., Corley, K. G., and Hamilton, A. L. 2013. "Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology," *Organizational Research Methods* (16:1), pp. 15-31.
- Glaser, B. G., and Strauss, A. L. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*, (1 ed.). Chicago, IL: Aldine Publishing Company.

- Gregory, R. W., Kaganer, E., Henfridsson, O., and Ruch, T. J. 2018. "It Consumerization and the Transformation of It Governance," *MIS Quarterly* (42:4), pp. 1225-1253.
- Gulati, R., Puranam, P., and Tushman, M. 2012. "Meta-Organization Design: Rethinking Design in Interorganizational and Community Contexts," *Strategic Management Journal* (33:6), pp. 571-586.
- Henfridsson, O., and Bygstad, B. 2013. "The Generative Mechanisms of Digital Infrastructure Evolution," *MIS Quarterly* (37:3), pp. 907-932.
- Hsieh, Y. Y., Vergne, J. P., Anderson, P., Lakhani, K., and Reitzig, M. 2018. "Bitcoin and the Rise of Decentralized Autonomous Organizations," *Journal of Organization Design* (7:1), pp. 1-16.
- Huber, T. L., Kude, T., and Dibbern, J. 2017. "Governance Practices in Platform Ecosystems: Navigating Tensions between Cocreated Value and Governance Costs," *Information Systems Research* (28:3), pp. 563-584.
- Kellogg, K. C., Valentine, M. A., and Christin, A. 2019. "Algorithms at Work: The New Contested Terrain of Control," *Academy of Management Annals* (14:1), pp. 366-410.
- Kenney, M., and Zysman, J. 2016. "The Rise of the Platform Economy," *Issues in Science and Technology* (32:3), pp. 61-69.
- Kyber Network. 2019. "Kyber: An on-Chain Liquidity Protocol." *White Paper* Retrieved March 17, 2021, from https://files.kyber.network/Kyber_Protocol_22_April_v0.1.pdf
- Kyber Network. 2020. "Kyberdao: Staking and Voting Overview." Retrieved March 19, 2021, from <https://blog.kyber.network/kyberdao-staking-and-voting-overview-70be71ee58fo>
- Lessig, L. 2006. *Code: Version 2.0*. New York, NY: Basic Books.
- Lindman, J., Tuunainen, V., and Rossi, M. 2017. "Opportunities and Risks of Blockchain Technologies in Payments – a Research Agenda," *50th Hawaii International Conference on System Sciences*.
- Lumineau, F., Wang, W., and Schilke, O. 2021. "Blockchain Governance—a New Way of Organizing Collaborations?," *Organization Science* (32:2), pp. 500-521.
- MakerDAO. 2017. "The Maker Protocol: Makerdao's Multi-Collateral Dai (Mcd) System." *White Paper* Retrieved March 18, 2021, from <https://makerdao.com/en/whitepaper/>
- MakerDAO. 2018. "Makerdao Governance Risk Framework (Part 3)." Retrieved March 19, 2021, from <https://blog.makerdao.com/makerdao-governance-risk-framework-part-3/>
- Moehlmann, M., Zalmanson, L., Henfridsson, O., and Gregory, R. 2021. "Algorithmic Management of Work on Online Labor Platforms: When Matching Meets Control," *MIS Quarterly* (Forthcoming).
- MolochDAO. 2020. "Moloch V2." *White Paper* Retrieved March 19, 2021, from <https://github.com/MolochVentures/moloch>
- Murray, A., Kuban, S., Josefy, M., and Anderson, J. 2019. "Contracting in the Smart Era: The Implications of Blockchain and Decentralized Autonomous Organizations for Contracting and Corporate Governance," *Academy of Management Perspectives* (Forthcoming).
- Murray, A., Rhymmer, J., and Sirmon, D. 2020. "Humans and Technology: Forms of Conjoined Agency in Organizations," *Academy of Management Review* (Forthcoming).
- Nakamoto, S. 2008. "Bitcoin: A Peer-to-Peer Electronic Cash System." *White Paper* Retrieved April 1, 2021, from <https://bitcoin.org/bitcoin.pdf>
- Niederman, F., Ferratt, T. W., and Trauth, E. M. 2016. "On the Co-Evolution of Information Technology and Information Systems Personnel," *SIGMIS Database* (47:1), pp. 29-50.
- O'Mahony, S., and Ferraro, F. 2007. "The Emergence of Governance in an Open Source Community," *Academy of Management Journal* (50:5), pp. 1079-1106.
- Oliveira, L., Zavolokina, L., Bauer, I., and Schwabe, G. 2018. "To Token or Not to Token: Tools for Understanding Blockchain Tokens," *39th International Conference on Information Systems*, San Francisco.
- Ostern, N. 2018. "Do You Trust a Trust-Free Technology? Toward a Trust Framework Model for Blockchain Technology," *39th International Conference on Information Systems*, San Francisco.
- Puranam, P., Alexy, O., and Reitzig, M. 2014. "What's "New" About New Forms of Organizing?," *Academy of Management Review* (39:2), pp. 162-180.
- Raisch, S., and Krakowski, S. 2021. "Artificial Intelligence and Management: The Automation-Augmentation Paradox," *Academy of Management Review* (46:1), pp. 192-210.
- Reischauer, G., and Mair, J. 2018. "Platform Organizing in the New Digital Economy: Revisiting Online Communities and Strategic Responses," in *Toward Permeable Boundaries of Organizations? (Research in the Sociology of Organizations, Vol. 57)*. Bingley: Emerald Publishing Limited, pp. 113-135.

- Risius, M., and Spohrer, K. 2017. "A Blockchain Research Framework: What We (Don't) Know, Where We Go from Here, and How We Will Get There," *Business and Information Systems Engineering* (59:6), pp. 385-409.
- Rossi, M., Mueller-Bloch, C., Thatcher, J. B., and Beck, R. 2019. "Blockchain Research in Information Systems: Current Trends and an Inclusive Future Research Agenda," *Journal of the Association for Information Systems* (20:9), pp. 1388-1403.
- Sambamurthy, V., and Zmud, R. W. 1999. "Arrangements for Information Technology Governance: A Theory of Multiple Contingencies," *MIS Quarterly* (23:2), pp. 261-290.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., and Jinks, C. 2018. "Saturation in Qualitative Research: Exploring Its Conceptualization and Operationalization," *Quality & Quantity* (52:4), pp. 1893-1907.
- Shin, L. 2021. "Can a Dao Go to Court? According to Two Dao Legal Experts... Probably." Retrieved July 14, 2021, from <https://unchainedpodcast.com/can-a-dao-go-to-court-according-to-two-dao-legal-experts-probably/>
- Soleimani, A., Bhuptani, A., Young, J., Haber, L., and Sethuram, R. 2019. "The Moloch Dao: Beating the Tragedy of the Commons Using Decentralized Autonomous Organizations." *White Paper* Retrieved March 18, 2021, from <https://github.com/MolochVentures/Whitepaper/blob/master/Whitepaper.pdf>
- Szabo, N. 1997. "Formalizing and Securing Relationships on Public Networks," *First Monday* (2:9).
- Tilson, D., Lyytinen, K., and Sørensen, C. 2010. "Digital Infrastructures: The Missing Is Research Agenda," *Information Systems Research* (21:4), pp. 748-759.
- Tiwana, A., and Kim, S. K. 2015. "Discriminating It Governance," *Information Systems Research* (26:4), pp. 656-674.
- Tiwana, A., Konsynski, B., and Bush, A. A. 2010. "Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics," *Information Systems Research* (21:4), pp. 675-687.
- Tiwana, A., Konsynski, B., and Venkatraman, N. 2013. "Special Issue: Information Technology and Organizational Governance: The It Governance Cube," *Journal of Management Information Systems* (30:3), pp. 7-12.
- Treiblmaier, H., Swan, M., De Filippi, P., Lacity, M., Hardjono, T., and Kim, H. 2021. "What's Next in Blockchain Research? - an Identification of Key Topics Using a Multidisciplinary Perspective," *SIGMIS Database* (52:1), pp. 27-52.
- Urbach, N., Ahlemann, F., Boehmann, T., Drews, P., Brenner, W., Schaudel, F., and Schuette, R. 2019. "The Impact of Digitalization on the It Department," *Business & Information Systems Engineering* (61:1), pp. 123-131.
- Vergne, J. 2020. "Decentralized Vs. Distributed Organization: Blockchain, Machine Learning and the Future of the Digital Platform," *Organization Theory* (1:4), pp. 1-26.
- Voshmgir, S. 2020. *Token Economy: How the Web3 Reinvents the Internet*. Berlin: Token Kitchen.
- Walsh, I., Holton, J. A., Bailyn, L., Fernandez, W., Levina, N., and Glaser, B. 2015. "What Grounded Theory Is...a Critically Reflective Conversation among Scholars," *Organizational Research Methods* (18:4), pp. 581-599.
- Wareham, J., Fox, P. B., and Cano Giner, J. L. 2014. "Technology Ecosystem Governance," *Organization Science* (25:4), pp. 1195-1215.
- Whetten, D. A. 1989. "What Constitutes a Theoretical Contribution?," *Academy of Management Review* (14:4), pp. 490-495.
- Wu, S. P.-J., Straub, D. W., and Liang, T.-P. 2015. "How Information Technology Governance Mechanisms and Strategic Alignment Influence Organizational Performance: Insights from a Matched Survey of Business and It Managers," *MIS Quarterly* (39:2), pp. 497-518.
- Yin, R. K. 2009. *Case Study Research and Applications: Design and Methods*. Thousand Oaks, CA: SAGE Publications.
- Ziolkowski, R., Miscione, G., and Schwabe, G. 2020a. "Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else's Shoes?," *Journal of Management Information Systems* (37:2), pp. 316-348.
- Ziolkowski, R., Miscione, G., and Schwabe, G. 2020b. "Exploring Decentralized Autonomous Organizations: Towards Shared Interests and 'Code Is Constitution'," *41st International Conference on Information Systems*, India.
- Zuboff, S. 2015. "Big Other: Surveillance Capitalism and the Prospects of an Information Civilization," *Journal of Information Technology* (30:1), pp. 75-89.

Essay 5: Skin in the Game in DAO Governance: A Dynamic Model of Collective Platform Ownership

Authors: Eleunthia Wong Ellinger, Universitat Ramon Llull, Spain
Tobias Mini, University of Passau, Germany
Robert W. Gregory, University of Miami, USA
Thomas Widjaja, University of Passau, Germany
Ola Henfridsson, University of Miami, USA

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Abstract

Prior platform governance research typically assumes a separation between the ownership of the platform and platform participation. This assumption directs attention to governance frameworks that benefit the centralized platform owner. However, high concentration of ownership typically limits and constrains the potential for collective action among platform participants. Early research suggests that more decentralized governance of platforms is promising for overcoming the asymmetry of value capture that typically exists in traditional digital platforms. In particular, blockchain-based decentralized autonomous organizations (DAOs) as a new form of organizing are often used to create and sustain their protocols by relying on collective action. However, little is known about the nature of decentralized governance and the implications of DAOs when used to address collective action problems. Informed by polycentric commons theory and intended to contribute to platform governance literature, we studied multiple DAOs and developed a dynamic model of collective platform ownership based on a case study of MakerDAO. The model consists of three polycentric governance mechanisms (structuring ownership, harnessing collective, and governing protocols) that explain how and why decentralized governance as implemented in DAOs facilitates collective action.

⁵ This list does *not* include presentations held by co-authors.

⁶ Essay 5 of this thesis is the 2nd round version of this manuscript submitted to MIS Quarterly with current status of “Major Revision” (May 26th, 2022). A 3rd round version of this manuscript is currently in preparation for resubmission to MIS Quarterly.

SKIN IN THE GAME IN DAO GOVERNANCE:

A DYNAMIC MODEL OF COLLECTIVE PLATFORM OWNERSHIP

Abstract: Prior platform governance research typically assumes a separation between the ownership of the platform and platform participation. This assumption directs attention to governance frameworks that benefit the centralized platform owner. However, high concentration of ownership typically limits and constrains the potential for collective action among platform participants. Early research suggests that more decentralized governance of platforms is promising for overcoming the asymmetry of value capture that typically exists in traditional digital platforms. In particular, blockchain-based decentralized autonomous organizations (DAOs) as a new form of organizing are often used to create and sustain their protocols by relying on collective action. However, little is known about the nature of decentralized platform governance and the implications of DAOs when used to address collective action problems. Informed by polycentric commons theory and intended to contribute to platform governance literature, we studied multiple DAOs and developed a dynamic model of collective platform ownership based on a case study of MakerDAO. The model consists of three polycentric governance mechanisms (*structuring ownership, harnessing collective, and governing protocols*) that explain how and why decentralized governance as implemented in DAOs facilitates collective action.

Keywords: Platform governance, decentralization, distributed ledger technology, decentralized autonomous organizations, collective ownership, collective action, polycentric commons

INTRODUCTION

The adoption and diffusion of distributed ledger technologies are quickly accelerating across the globe (Beck et al., 2018). Such technologies have been used to establish new decentralized networks, often viewed with the potential to democratize access to financial services (Omarova, 2020). For example, as of March 6, 2021, \$196 billion had been locked up in Decentralized Finance (DeFi) protocols¹, highlighting the significance of decentralized autonomous organizations (DAOs), a new form of organizing often used to create and sustain blockchain protocols. Approximately 4,000 DAOs are in operation, with hundreds of thousands of people participating globally and recent recognition as a legal structure in the U.S. state of Wyoming².

DAOs, as collectively owned production communities, rely on a set of self-executing rules deployed on a public blockchain to enact decentralized governance by the members and with the goal of achieving collective outcomes (Beck et al., 2018; Hassan, 2021; O'Mahony & Ferraro, 2007). Many DAOs can be seen as platforms in that they enable value-creating interactions between multiple stakeholders (cf. Constantinides et al., 2018). Yet, DAOs exhibit a new form of platform governance. DAOs indicate a shift from governance orchestrated by a dominant platform owner (Constantinides et al., 2018; Parker et al., 2017; Tiwana et al., 2010), to more decentralized forms of governance (Chen et al., 2021; Vergne, 2020; Zachariadis et al., 2019; Ziolkowski et al., 2020) through actions performed voluntarily by their members. The decentralized platform governance of DAOs provides a codified decision-making framework, enabled by smart contracts and complementary cryptocurrencies (Meyer, 2020; O'Mahony & Ferraro, 2007; Rozas et al., 2021). As an example, the common aim of DAOs in the DeFi space is to establish alternative decentralized models to democratize access to financial products, and

¹ <https://news.bitcoin.com/value-locked-in-defi-sheds-55-billion-in-2-months-ethereums-defi-dominance-loses-14/>

² <https://unchainedpodcast.com/can-a-dao-go-to-court-according-to-two-dao-legal-experts-probably/>

to democratize the policymaking for and management of these financial instruments, operating with hundreds of millions of dollars of daily trading volume despite operating largely outside of existing regulatory infrastructure.

Prior research on platforms typically examines centralized forms of governance, where the platform owner develops the governance framework that controls the value-creating interactions on the platform (Brunswick et al., 2019; Tiwana et al., 2010). Even though such platform governance incentivizes the participation of non-focal actors (see, e.g., Hukal et al., 2020; Selander et al., 2013), the concentration of ownership typically limits and constrains the potential for collective action among platform participants. In other words, there exists a clear separation between platform ownership as reflected in, for instance, decision rights (Tiwana et al., 2010) and platform participation. For example, Facebook and Uber exert distinct platform ownership as they extract data generated by users' platform participation (Gregory et al., 2021; Moehlmann et al., 2021) for further platform development and monetization opportunities.

In contrast, DAOs create and sustain themselves through collective action, defined as voluntary cooperative behavior among rational, self-interested individuals with common interests (Olson, 1965; Ostrom, 2000). This dynamic can benefit all members, yet, in turn, collective action problems arise from the opportunity of individuals to pursue their own interests at the expense of pursuing a common goal (Bridoux & Stoelhorst, 2020; Olson, 1965; Ostrom, 2010). Contextualized to DAOs, the freedom of association of members, to engage yet to also be able to stop their participation at any time without incurring a loss of opportunity, poses a constant threat to DAOs, which can fail after an exodus of its members or even through member apathy, causing a lack of attention that can eventually cause a fatal misalignment between the DAO and its rapidly changing environment. As every actor – irrespective of their own contributions – can

benefit from the resulting DAO, free riding is also possible. If all individual actors were to maximize myopic short-term benefits, this aggregated individual behavior would generate less favorable outcomes than the outcomes that could have been generated by cooperation (Ostrom, 2010, p. 155). The examination of governance in DAOs offers an opportunity to generate insights about the role of collective ownership for platform governance. We accordingly seek to contribute to the platform governance literature by addressing the research question: *how and why does decentralized governance as implemented in DAOs facilitate collective action?*

We studied multiple DAOs with a focus on MakerDAO and the intention to build phenomenon-based theory (Fisher et al., 2021) grounded in rigorous case analysis (Birks et al., 2013; Gerring, 2006). DAOs manifest governance, where many platform participants have *skin in the game* (Taleb, 2018) through holding governance tokens that give them a voice in the decentralized governance of the platform. To analyze the findings, we used the theory of polycentric commons (Mindel et al., 2018; Ostrom, 1990), as a lens to develop explanatory polycentric governance mechanisms, operating as a set of unique processes in a system that work together to drive outcomes (Bunge, 2004). We contribute to platform governance literature by developing a dynamic model of collective platform ownership. The model consists of three mechanisms (*structuring ownership, harnessing collective, and governing protocols*) that explain how and why decentralized governance as implemented in DAOs facilitates collective action.

CONCEPTUAL BACKGROUND

Platforms: From Centralized to Decentralized Governance

The diffusion of the Internet has repeatedly expanded and redefined industry boundaries (Afuah, 2003; Gawer, 2014). Creating data-driven economies of scale and scope (Gregory et al.,

2021), platforms³ have been particularly prominent in demonstrating this impact (Constantinides et al., 2018; Kraemer & Schnurr, 2021). Yet the ‘platform economy’ (Kenney & Zysman, 2016) is widely recognized to be dominated by a small number of platforms that leverage data collected on each user to control, influence, and shape behaviors, expectations, whims, habits, and emotions (Moehlmann et al., 2021). The dominance of these platforms is reinforced by centralized governance where the platform owner aggregates ownership of resources, decision-making authority, and control over platform workers and complementors (Tiwana et al., 2010).

In the current platform governance literature, centralized platform ownership is often taken for granted. Table 1 lists platform governance studies that epitomize the dominance of centralized platform ownership assumptions in current research, evident in explanations about how the platform owner: sets up a revenue-sharing model (Ghazawneh & Henfridsson, 2013); launches an app that complementors view as an exogenous shock (Foerderer et al., 2018); fosters innovation by outsiders (Huber et al., 2017; Tiwana, 2015; Wareham et al., 2014); shapes platform work (Moehlmann et al., 2021); and makes the decisions about platform architecture (Brunswick et al., 2019). Even studies that focus on complementors make assumptions about platform centralization. Consider, for instance, how Selander et al. (2013) describe a non-focal actor as an “ecosystem participant who is at the periphery of a digital ecosystem” (p. 183).

Table 1. Centralized Platform Ownership Assumptions in Platform Governance Research		
Paper	Empirical context	Example excerpt
Ghazawneh and Henfridsson (2013)	Apple iOS platform	“the platform owner can set up a revenue sharing business model where a specific portion of the revenue is withheld as a compensation for the distribution and support of the applications” (p. 174)
Foerderer et al. (2018)	Photography app market of the Android platform	“many photography-related apps existed before Google’s entry and the release of Photos is an exogenous shock to complementors and their innovation outcomes.” (p. 445)

³ Platforms are meta-organizations that enable value-creating interactions between multiple autonomous stakeholders (cf. Constantinides et al., 2018; Gawer, 2014).

Tiwana (2015)	Firefox browser and browser extensions	"Platform owners are increasingly organizing ecosystems to foster innovation by diverse outsiders" (p. 266)
Moehlmann et al. (2021)	Uber	"...algorithmic management shapes platform work, and eventually induces different responses by platform workers" (p. 2018)
Brunswick et al. (2019)	Simulation, NK model	"What is the relationship between an owner's decisions about the platform architecture and platform performance..." (p. 1251)
Huber et al. (2017)	Two platform owners: Alpha and Beta	"By designing ecosystem-wide governance, platform owners try to strike a balance between standardizing across contexts to efficiently orchestrate large ecosystems and being sensitive to the local needs of individual complementors" (p. 564)
Wareham et al. (2014)	Vendor of ERP software suite	"Using purposefully designed governance mechanisms, such platforms can promote contributions of autonomous actors to create complementary products and services" (p. 1195)

Due to a number of issues, including the abuse of centralized power and the lack of control by users to protect and advance their own interests, the degree of centralization of platform ownership in today's platform economy is increasingly considered too high (Hassan, 2021; Iansiti & Lakhani, 2017). Recent research suggests that implementing more decentralized governance via new combinations of digital technology and organization design may help online communities and open-source movements advance their agendas for social and economic progress (Barrett et al., 2016; Chen et al., 2021; Faik et al., 2020). Making governance more collective entails distributing decision-making authority throughout a network of platform users, transitioning from unilateral to more bidirectional forms of control where the line between core and peripheral actors becomes blurry, and creating conditions for shared ownership of commons (Constantinides & Barrett, 2015; Tiwana et al., 2010).

Given this context, the rise of DAOs is significant. DAOs hold the promise to be production communities that are collectively owned by their members whose governance is decentralized, that is, independent from central control, by relying on a set of self-executing rules deployed on a public blockchain with the goal of achieving collective outcomes (Beck et al., 2018; Hassan, 2021; O'Mahony & Ferraro, 2007). For example, MakerDAO, recognized as one

of the most successful and mature DAOs, achieves a decentralized form of platform governance involving self-executing rules and collective protocol governance by MKR token holders of a smart-contract service built on the Ethereum blockchain, allowing lending and borrowing of cryptocurrencies without the need for a middleman. MakerDAO is part of the Decentralized Finance (DeFi) movement that seeks to collectively develop and own financial instruments without relying on intermediaries such as brokerages, exchanges, or banks.

On the one hand, the development, and evolution of DAOs bear similarities with open-source projects in that their governance is “decentralized, collaborative, and nonproprietary; based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on...managerial commands” (Benkler, 2006, p. 121). On the other hand, decentralized governance in DAOs is also unique due to the collective form of ownership they implement, based on: the design and use of cryptographic assets or tokens (Cennamo et al., 2020); the creation of value-based incentives that extend beyond reputation, control, and learning (von Hippel & von Krogh, 2003); and the introduction of more formalized, systematic, and automated processes defining the common rules for participation and control (Chen et al., 2021; Lumineau et al., 2021; Murray et al., 2021; Tiwana et al., 2010; Ziolkowski et al., 2020). As a result of these unique characteristics of DAOs, every user is more likely to have *skin in the game* based on collective ownership, reducing the asymmetry common in centralized platform governance, where the platform owner gets most of the rewards and whereas the users are oftentimes stuck with the risks (Foerderer et al., 2018; Taleb, 2018).

Decentralized Autonomous Organizations (DAOs) as Polycentric Commons

The phenomenon of DAOs can be evaluated through the lens of *polycentric commons* (Mindel et al., 2018; Ostrom, 1990). Research on commons – resources that are shared,

accessible, and democratically managed for and by communities – has extended its focus from natural and material common-pool resources such as communal land, forest, and the climate (Ostrom, 1990) to the digital technology-enabled pool of human-made and immaterial resources for addressing collective needs, including examples such as open-source software and cryptocurrencies⁴ (Meyer, 2020; O'Mahony & Ferraro, 2007). DAOs function as commons that exhibit polycentricity – polycentricity refers to an arrangement involving many centers of decision making that are formally independent of each other and mutually adjust to create ordered relationships within a larger system of rules (Aligica & Tarko, 2012; Ostrom et al., 1961). Even though many DAOs seek to implement a more decentralized form of platform governance to democratize access and control of value creation and capture for every user, the governance of these DAOs also involves unique challenges that produce centralization-decentralization-recentralization dynamics. These challenges require the use of unique polycentric mechanisms that promote order and mutual adjustments of relationships within a general system of rules that is constantly evolving (Mindel et al., 2018).

Creating and sustaining DAOs involve the use of polycentric mechanisms that help address collective action problems. The central challenge stems from the fact that DAOs sustain themselves through voluntary contributions and are highly accessible (Mindel et al., 2018).

Individual actors are free to join, to contribute, and use DAO resources (regardless of the individual contribution), but they may also abandon it (Olson, 1989). This freedom to enter and

⁴ Over the last decade, information systems research started to focus on digital commons as a sub-type of human-made commons (Constantinides & Barrett 2015). Digital commons have specific characteristics. First, they are highly accessible in the sense that actors are free to enter, use, and exit the commons (Mindel et al. 2018). Second, due to the specifics of digital artifacts and, in particular, its immateriality, the “tragedy of the commons” associated with the subtractability of use of natural material resources (Ostrom 2010), is often transformed by network effects to the “comedy of the commons” (Rose 1986). Third, in IS research on collective action, “the good is not the information system itself, but the functionalities that it affords, and the willingness (interest) and capabilities (resources) of the users to take advantage of those affordances” (Constantinides & Barrett, 2015, p. 42). For example, in Cennamo & Santaló (2019), the good produced by the collective is conceptualized as the reputation of the platform.

exit creates opportunities for change, financial inclusion, and other forms of social and economic progress that support the DAO movement (Zachariadis et al., 2019), but also poses a constant threat to the sustainability of the polycentric common (Mindel et al., 2018). The organization can fall apart through forking or community splits at any time (Andersen & Bogusz, 2019), or simply fail to evolve and adapt to environmental changes due to the inertia caused by member apathy. If each individual actor acts to maximize their own short-term benefits without regard for the collective benefit, this collective myopia generates reduced outcomes in comparison to those achieved through cooperative behavior (Ostrom, 2010, p. 155). Subsequently, the dynamics related to the individual decision to contribute to the DAO's development or to free-ride resembles the prisoner's dilemma, the "canonical representation of collective action problems" (Ostrom, 2000, p. 137).

Since existing research on polycentric commons focuses on conditions under which individual actors collaborate to achieve common goals – even in situations where personal maximization calculus would lead to free-riding or inertia – polycentric commons is a suitable lens to understand the relationship between decentralized governance and collective action. A key topic addressed by research on polycentric commons is governance (Ostrom, 1990). In this respect, established DAOs such as MakerDAO are decentralized and involve many independent decision-making centers, resulting in a high degree of inclusivity in decision-making.

METHODOLOGY

To answer our research question of how and why decentralized governance as implemented in DAOs facilitates collective action, we studied multiple DAOs with a focus on MakerDAO, employing the related qualitative approaches of grounded theory building and exploratory case study (Gerring, 2006; Urquhart, 2013). MakerDAO provides an excellent

setting to investigate our research question and build new grounded theory from empirical observations (Urquhart, 2013) because this DAO is a platform (Constantinides et al., 2018) enabling interaction between vault owners and Dai users, as well as fitting the criteria for the extreme-case selection technique described by Gerring (2006). MakerDAO scores highly on key variables of interest in our study, including decentralized governance and sustained ability to facilitate collective action, making the case a “paradigmatic” instance (Gerring, 2006, p. 101) of the wider DAO movement and phenomenon. In other words, analyzing the MakerDAO case allowed us to focus on the relationship between decentralized governance and collective action (cf. research question), paving the way for generalizing from description to theory (Lee & Baskerville, 2003).

Data Collection and Theoretical Sampling

We used multiple sources of evidence across two waves of data collection and analysis (Gerring, 2006). This data was collected and analyzed over the course of 15 months. The first wave of data collection focused on the DAO phenomenon at large, including the analysis of multiple DAOs (see Table 2). Subsequently, for the reasons explained above, we constrained our study to the MakerDAO case during the second wave of data collection for a more in-depth analysis of emergent themes and patterns. The dataset as a whole includes 23 semi-structured interviews, observations of 20 governance and risk meetings, and 1,055 pages of archival data.

The starting point for this study was the identification of DAOs as a rising organizational and socio-economic phenomenon. First, we analyzed technical documentation of five well-known DAOs (i.e., MakerDAO, KyberDAO, Flare Networks, Aragon, and MolochDAO) in order to develop a comprehensive understanding of this novel phenomenon. Our analysis of archival data (i.e., white papers, blog articles, podcast interviews, and technical documentation)

during Wave 1 surfaced decentralized governance implemented in DAOs as the basis for facilitating collective action through *collective ownership* as the overarching theme of our study. This initial discovery guided our process of theoretical sampling (Glaser, 1978), influencing our decision to sample new data across the two waves of the study.

Table 2. Data Collection	
	Method and Sources
Wave 1: December 2020 – November 2021	<p>Archival data including white papers, blog articles, podcast interviews, and technical documentation of DAOs (1,055 pages collected):</p> <ul style="list-style-type: none"> • MakerDAO (12 documents; 315 pages coded) • Other DAOs: KyberDAO, Flare, MolochDAO, Aragon (9 documents; 547 pages coded) <p>8 semi-structured interviews with DAO stakeholders from ElasticDAO, MiamiDAO, BanklessDAO, Aragon, CommonsStack, DAO investor (recorded and transcribed) and participant observation of an associated Miami Bitcoin meeting (field notes written)</p>
Wave 2: November 2021 – March 2022	<p>15 semi-structured interviews with core MakerDAO stakeholders (recorded and transcribed; writing of field notes), including three current delegates, a member of the protocol engineering core unit, a former delegate & whale investor, two facilitators/leaders of the governance core unit, the collateral engineering services core unit leader (interviewed twice), the sustainable ecosystem core unit leader, the facilitator of the development & UX core unit (interviewed twice), the facilitator of the governance communications core unit, a DAO co-founder & facilitator of the auction services core unit, and two members of the collateral engineering services core unit</p> <p>Observation and detailed analysis of MakerDAO stakeholders at 20 governance and risk meetings (~ 20 hours of observation and writing of field notes)</p> <p>Informal dialogue with core stakeholders from MakerDAO over Discord over a four-month period</p> <p>Archival data of MakerDAO’s evolution including archival video material of 182 governance and risk meetings, 21 blog articles (https://forum.makerdao.com), and 6 Maker Improvement Proposals (https://mips.makerdao.com/mips/list)</p>

To explore the boundaries of our emerging grounded theory, we extended our sampling of primary data (Urquhart, 2013) in Wave 1 by conducting 8 semi-structured interviews with key DAO stakeholders from ElasticDAO, MiamiDAO, BanklessDAO, Aragon, CommonsStack, and a DAO investor and through participant observation at a Bitcoin meetup in Miami, for which field notes were written. The interviews and observation allowed us to understand the motivation and experience of stakeholders in becoming active participants, making decisions, and acquiring ownership in DAOs in the form of tokens. The analysis of this primary data revealed that DAOs,

in their unique enactment of community participation, collective ownership, and smart-contract protocol governance, particularly embodied a decentralized governance model that promised to address collective action problems such as free riding and whale dominance, or the tendency for large-scale investors such as venture capital firms to hold a significant portion of a DAO's tokens and thereby marginalize other stakeholder groups.

These tentative categories provided the analytic ground for the second wave of data collection (see Table 2) to collect further evidence for the substantiation and conceptualization of the emergent categories, all in the spirit of theoretical sampling and by constantly comparing different data slices with each other (Urquhart, 2013), ultimately with the goal of adding depth to our analysis. As explained above, MakerDAO became a key focus of our study over time as it became clearer to us how it fits the criteria for the extreme-case selection technique (Gerring, 2006). We conducted an intensive case study of MakerDAO where we immersed ourselves heavily into the MakerDAO community. We conducted additional 15 semi-structured interviews with core stakeholders of MakerDAO including core unit team members, governance facilitators, and vote delegates. We re-analyzed the MakerDAO white paper and technical documentation to understand the code snippets or smart contract functionalities mentioned by interviewees.

Over time, we gained the trust of core MakerDAO stakeholders who granted us the right to participate in weekly governance and risk meetings to study interactions among stakeholders as they discussed core decisions of the DAO. To understand the discussions happening during these meetings, we combed regularly through MakerDAO's extensive online governance forums and Discord governance channels, and we interacted regularly with stakeholders on Discord to better understand topics from the governance and risk meetings. This exhaustive additional data collection and analysis of the MakerDAO case allowed us to conceptualize three analytical

categories – *governing protocols*, *structuring participation*, and *harnessing collective* – that in combination speak to the emerging core category of collective platform ownership.

Data Analysis

Data analysis and collection activities were intertwined across both waves described above. We used techniques of grounded theory (Birks et al., 2013; Charmaz, 2006; Gioia et al., 2013; Urquhart, 2013) to iteratively build inductive theory. Open coding (Glaser & Strauss, 1967) of the different data sources was performed by two authors separately using the coding software MAXQDA, which led to initial first-order categories that remained close to our data (Gioia et al., 2013). Exemplary first-order categories were *voting through tokens* or *earning through tokens*. Following open coding, as the second step, we constantly compared first-order categories to identify relationships and to aggregate them into second-order themes (Gioia et al., 2013). For example, the two first-order categories mentioned above led to the second-order theme *designing dual-value tokenization*. In the third step, all members of the author team regularly discussed the results and challenges of the coding, interrogating each other's interpretations, and proposing alternative explanations, resulting in refined first-order categories, second-order themes, and conceptualizations of the final mechanisms (Gioia et al., 2013). In addition, we gained feedback from key informants in the MakerDAO community to sharpen our conceptualizations. For instance, over time we assessed that the second-order themes of *designing dual-value tokenization* and *architecting decision networks* were closely related to DAOs baseline stakeholder investing and shaping of the platform yet distinct from each other and bundled them into the mechanism of *structuring participation*. To maintain theoretical sensitivity (Glaser, 1978) and to scale up our emerging theory (Urquhart, 2013) we regularly compared emerging concepts with the theory of polycentric commons (e.g., Mindel et al., 2018;

Ostrom, 1990) and literature on platform governance (e.g., Chen et al., 2021; Tiwana et al., 2010). The iterative coding and theoretical development stopped when we achieved a reliable and valid treatment of the mechanisms. This theoretical saturation (Charmaz, 2006; Glaser & Strauss, 1967; Saunders et al., 2018) was visible when the number of new first-order categories emerging from each additional case material decreased and no new second-order themes or mechanisms emerged from the data. Finally, we synthesized our findings about the theoretical interrelationships of key themes and mechanisms into a dynamic model (see Figure 5).

FINDINGS

Introduction to the Research Site and Setting

The concept of DAO emerged shortly after the establishment of Bitcoin as a cryptographic digital asset and Ethereum as a smart contract blockchain. After analyzing several white papers to understand the technical function of DAOs, we began conducting interviews with DAO participants and noted a common theme of inclusion and societal value in their statements. First, one participant of the newly formed MiamiDAO described an optimistic opportunity for the DAO to add value to society:

“I see an opportunity to fill the cracks that exists in the edifices which is the state of civilization...what we could do is we can fill these cracks with a new form of organization, a new way of cooperating and decision making...I see so much wasted resources, time, energy and ideas that we could tremendously increase the value that we have in our society.”

In a second DAO, Aragon, the head of governance spoke at length about not only providing more opportunities for people of all financial backgrounds to participate, and even be rewarded:

“One of the main challenges I'm trying to think through and work through with my team is figuring out how...we can increase the quality of decisions being made, be more equitable in that is not only the big holders who can afford to participate, actually anyone can afford to participate and be rewarded.... And more open and more permissionless so other people can join these structures and from the early stages of joining, finding ways to add value and being rewarded... We're trying to get decentralization of power, or avoid an excessive centralization of power, and I believe more in, let's say, a polycentric approach.”

In a third DAO called Bankless, one participant described starting by “just hanging out in [the DAO Discord channel] to kind of get a vibe for what's going on” and ultimately becoming a leader in the organization due to the collective recognition of her iterative contributions. She talked about finding it easy to contribute at her DAO, noting a sense of “collective ownership”:

“[The DAO] has much more of a feeling of being more grassroots, like bottom up. There's definitely a sense of camaraderie among everyone, where it's like, we're all building something together. There's like, collective ownership of the space.”

The impetus to better understand how a DAO could imbue the characteristic of collective ownership led us to one of the earliest decentralized finance applications: MakerDAO was announced by Rune Christensen in 2015 with the vision of providing a “stablecoin built on Ethereum”⁵. The MakerDAO stablecoin, called “Dai” at the launch in 2017, is soft-pegged to the US dollar to keep its value stable without relying on any outside banking system and achieved through a governance token called “MKR.” Since the price of MKR is bound to the performance of the DAO, its holders have a financial incentive to balance supply and demand of Dai tokens through their purposeful governance voting decisions, as exemplified in the white paper⁶:

“MKR holders can mitigate the price instability by voting to modify the DSR accordingly: If the market price of Dai is above 1 USD, MKR holders can choose to gradually decrease the DSR, which will reduce demand and should reduce the market price of Dai toward the 1 USD target price. If the market price of Dai is below 1 USD, MKR holders can choose to gradually increase the DSR, which will stimulate demand and should increase the market price of Dai toward the 1 USD target price.”

Since MakerDAO survived multiple governance issues and major cryptocurrency shocks over time, it recently announced that the foundation that initially bootstrapped and maintained the DAO would deactivate such that “MakerDAO is now completely decentralized” and that “the global Maker community is now responsible for every aspect of the Maker Protocol and the

⁵ https://www.reddit.com/r/ethereum/comments/30f98i/introducing_edollar_the_ultimate_stablecoin_built/

⁶ <https://makerdao.com/en/whitepaper/>

DAO”⁷. The fact that MakerDAO functions as a fully decentralized organization and furthermore, is recognized as being one of the most developed and enduring DAOs, creates a novel setting to shed light on how and why decentralized governance as implemented in DAOs facilitates collective action, explained in the following.

A Grounded Theory of Collective Platform Ownership

We delineate key mechanisms explaining collective platform ownership: *structuring ownership*, *harnessing collective*, and *governing protocols* (see Table 3). These mechanisms interact with each other to facilitate collective action in the decentralized governance of the DAO platform.

Mechanism	Definition	Themes
Structuring Ownership	The process by which DAOs baseline stakeholder investing and shaping of the platform, enabling decentralized member actions.	<ul style="list-style-type: none"> • Designing dual-value tokenization: Stakeholders vote and earn through tokens, with tradeoffs. • Incentivizing engaged activity: Stakeholder attention to the platform yields rewards. • Architecting decision networks: Checks and balances, and trust in delegates, advance decentralized platform activity.
Harnessing Collective	The process by which DAOs maximize participation while maintaining distinctness of stakeholders and reinforcing formal procedures.	<ul style="list-style-type: none"> • Giving open rules of engagement: The platform opens dialogue, forms culture, and reinforces decentralization. • Discussing in public: Problems are considered openly and community sentiment is channeled, with some limits to transparency. • Navigating intentionally fuzzy boundaries: Stakeholders exercise voting power while building alliances and developing political tactics.
Governing Protocols	The process by which DAOs make key decisions regarding the evolution of the protocols while ensuring automated processes reflect interests of the collective.	<ul style="list-style-type: none"> • Integrating off-chain and on-chain decisions: Collective dialogue informs automated process. • Scaling human-machine governance: Ongoing monitoring spurs operational improvements and thoughts for future evolution. • Tuning protocols: Stakeholders focus on discreet problems and developing new solutions.

⁷ <https://blog.makerdao.com/makerdao-has-come-full-circle/>

Structuring Ownership

The mechanism of *structuring ownership* explains how DAOs baseline their stakeholder investing and shaping of the platform, which results in enabling decentralized actions on the part of their members (see Figure 1 for an excerpt from our data structure).

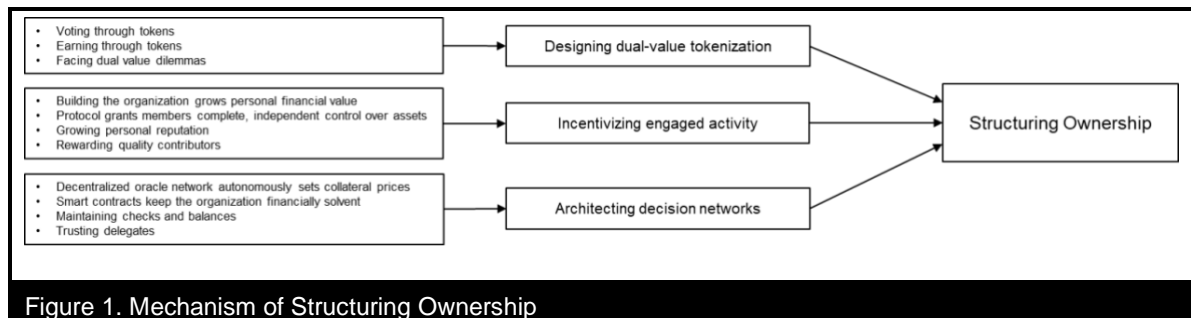


Figure 1. Mechanism of Structuring Ownership

Designing dual-value tokenization: MakerDAO, like many DAOs, designated tokens, called MKR and purchased by stakeholders, which conferred both the potential to earn by investment and the explicit right to vote on formal platform governance decisions. This dual value opened novel, substantive possibilities for token holders. On the voting side, the weight of these tokens was a simple calculation, where the more tokens held, the more votes exercised, as explained by a collateral engineering services core unit team member:

“You can invest any amount you want. You could vote with as little as zero point and then 18 decimals, one MKR. ... the more MKR you have, the more votes you have. If you have one MKR and I have two MKR, then I have twice as much voting power, essentially. So there isn’t any limit, but obviously, the more MKR you have, the more power you have.”

In our study, MakerDAO stakeholders were consistent in describing the “voting through tokens” system as inclusive of “whales,” those who own sizable portions of tokens but who are often relatively disengaged, while simultaneously acknowledging the chance that new investors could change the dynamic, similar to shareholders in a corporation, but with potentially more volatility and more impact. Said one stakeholder:

“People who have been contributing early and who were part of the founding team, they still hold a lot of the voting power, but in theory, anyone could buy those tokens and just start voting and influence the DAO.”

A former vote delegate and whale investor maintained a more dire outlook about the danger of the DAO being taken over by outsiders who buy up votes through tokens:

“For the MKR token to have value, it must have use cases...you must be able to use it for something. And the problem is, if you are using the token [not] to vote, that means that when you use it for other things, all the tokens will migrate all over crypto. And then, for example, exchanges can buy up a whole bunch of these tokens and then use this to manipulate voting in the DAO without really having any responsibility for what they're voting for.”

By all accounts, only a small fraction of token holders at MakerDAO voted. The common wisdom was that most stakeholders are in the DAO to earn through tokens: “they just want to hold a token and speculate,” as one meeting participant voiced at a public governance and risk meeting. It costs gas⁸ to vote, which disincentivized both those speculative token holders who simply want to earn on their investment, potentially over the short-term, as well as smaller token holders with small budgets. Meanwhile, there were token holders who considered themselves to be long-term investors, for instance, those who joined working teams in the DAO, called core units, and were being compensated by tokens:

“The individuals who are part of a core unit, and who have been part of the core unit for a very long time, they have a vested interest in Maker. For example, if I will stick with Maker for a long time, I will get MKR tokens, like, vested. So I actually have a more long-term vision or a long-term incentive, versus people that currently hold MKR tokens. I mean, they are incentivized to just make sure that those MKR tokens outperform, for example, Ether or Bitcoin, in this market cycle. So that's like a timeframe of a couple of months...that's where we're at, friction is happening.”

The clash between short-term and long-term incentive perspectives among token holders described above creates tension in the dual-value tokenization model as different types of stakeholders advance their interests. Governance may be executed in part by those who have no

⁸ Gas refers to fees that the Ethereum protocol charges for processing a transaction or smart contract.

long-term interest in the success of the platform. One stakeholder expressed a wish that those who agreed to “lock up” and hold their MKR tokens for a couple of years be bestowed voting power for making this commitment. This same stakeholder described another dual-value dilemma, lamenting the platform rules that disallowed tokens in “earn” mode to be used simultaneously in “vote” mode, that tokens had dual value but had to be converted for single-use:

“I think for something like governance polls, I wouldn't understand why it's not possible to use my MKR tokens that are earning yield, for example, in other words why I'm not able to use them in governance.”

At the same time, even with the difficulties described, enthusiasm prevailed among a wide range of members participating in governance with dual-value tokens in the DAO. As a current vote delegate described:

“People who are participating here and are also part of the voting systems and not only of the democratic thing [the forum discussions], but also of the on-chain thing, have really, skin in the game, in terms of it's not only about being part of a nice project, that you would be in an open-source world ... but it's also about an investment thing. So, you have a direct incentive of the product running better than before, because then essentially, your investment would be better.”

Having “skin in the game” made it worth the effort to engage in DAO governance, because of the potential of financial rewards simultaneously on the personal and organizational levels, and the satisfaction of playing a direct role in helping the DAO succeed.

Incentivizing engaged activity: Despite open engagement in MakerDAO overall, with the majority of tokens being used for speculation, the decentralized platform still needed a way of managing free riding so that “whale dominance” does not depress the DAO into a state of inertia, or worse, a downward spiral. In typical fashion for DAOs, MakerDAO gave material rewards for participation, as the facilitator of the development & UX core unit team described:

“I think that the fun part about crypto is that in the end, it really pays off to participate in the sense that...it's the only way to, for example, capitalize. Capitalize on all these yield farming opportunities...actually get your hands dirty.”

Additionally, many study informants had similar experiences where their efforts to build the organization grew their own personal value, such as this one:

“Started hanging around a little bit, bought MKR at some point during that time. And then you just kind of ended up getting more vote...[There are]incentives driving various actors with the aim of providing a stable currency.”

Others were hired into core units, were tasked with leading core units, or earned the trust of others to become voting delegates over time. The interweaving of personal performance with platform performance reinforced motivation to improve MakerDAO, as the facilitator of the governance communications core unit team described pointing to a stakeholder map (Figure 2):

“The closer you get inside [the shaded area in the stakeholder map], I would say the more there is to lose, like, MKR voters themselves are game-theoretically bound to the performance of the system. So if the system performs poorly, they get diluted. And you know, your proportional ownership goes down. Likewise, delegates, if they make bad decisions, they will lose their delegations. Likewise, if core units are incompetent, we will lose our jobs. And likewise, if something happens with the protocol, auction participants will, you know, all the work they did to produce their bots to make some profit will be for nothing.”

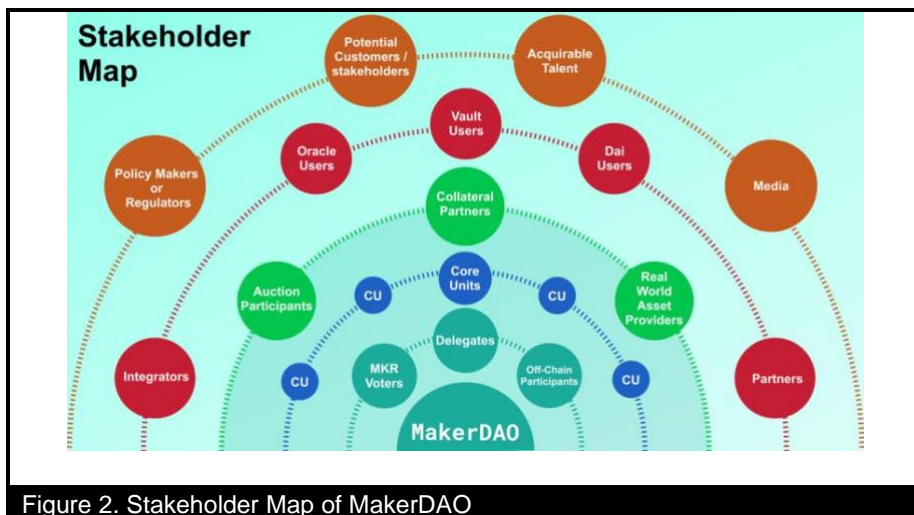


Figure 2. Stakeholder Map of MakerDAO

Members who became Vault Users (see Figure 2), opting to invest their assets in MakerDAO exercised high degrees of control over their vaults backed by smart contracts, which increased their incentive to engage with the protocol for potential financial reward. According to the MakerDAO protocol documentation:

“Vaults are inherently non-custodial: Users interact with Vaults and the Maker Protocol directly, and each user has complete and independent control over their deposited collateral as long the value of that collateral doesn’t fall below the required minimum level.”

Along with financial incentive, the ability to grow personal reputation at MakerDAO through amassing social capital in the platform’s highly public setting, also seemed to be widely recognized among stakeholders:

“So you have to make sure that you build some kind of profile, right, some kind of reputation. You have to be very deliberate about what you're trying to do. If I were to just write forum posts all the time, it will diminish my legitimacy in the DAO. And that applies to me. But that also applies to the founder of MakerDAO Rune, also very, very vocal and opinionated individual, [but] he doesn't have explicit mandate. I thought it to be very cool to see a lot of pushback on some of his initiatives over the past couple of weeks. Because that kind of legitimizes the claim that Maker is indeed a DAO, and we all need to deal with this opaque political process.”

Other stakeholders mentioned that the intangible quality of good personal reputation also sometimes translated into tangible job opportunities at companies.

One participant in a public governance and risk meeting opined, “Don't reward mere participation. Reward voters for getting educated about Maker.” Another participant at this same meeting agreed, responding that “we should be careful designing a solution that only rewards participation and precludes a solution that rewards meaningful, substantive, quality participation.” Following this line of thinking, stakeholders reported that MakerDAO rewarded individuals making high-quality contributions to the platform in two ways. One was that formalized voting delegates received a monthly grant, since we were told that the work involved to stay up-to-date on all of the proposals being discussed and associated information and news to read amounted to a part-time job. Another reward distribution was through participation in the forums, even by stakeholders with no tokens as described by a current vote delegate:

“Free riding is not going to hurt us...there's, for example, this incentive in the democratic platform in the forum...So if you participate in the forum, like 20 or 30,000 US dollars a month are being spread out to the people who are contributing in the forum. This is [called the] SourceCred mechanism [a MakerDAO protocol]. Which is totally not enough for people

who work there full-time, for example. But it's good enough for attracting new people, I would say.”

Architecting decision networks: The decentralized structure of MakerDAO meant that the DAO needed a decision structure closer to a network, despite having clear voting rights dedicated to token holders. One way that decisions were held in check is by coding them directly into the protocol, thereby establishing automated decision centers. For example, according to its documentation, MakerDAO maintained a “decentralized Oracle infrastructure that consisted of a broad set of individual nodes called Oracle Feeds” from which internal collateral prices were automatically determined. Furthermore, significant financial processes to keep MakerDAO solvent were executed and automated through smart contracts according to the protocol white paper:

“To ensure there is always enough collateral in the Maker Protocol to cover the value of all outstanding debt (the amount of Dai outstanding valued at the Target Price), any Maker Vault deemed too risky (according to parameters established by Maker Governance) is liquidated through automated Maker Protocol auctions. Once the Surplus Auction has ended, the Maker Protocol autonomously destroys the MKR collected, thereby reducing the total MKR supply. During a Debt Auction, MKR is minted by the system (increasing the amount of MKR in circulation), and then sold to bidders for Dai.”

Finally, in this series of financial smart contracts, MakerDAO (according to its technical documentation) employed a “system stabilizer module [that] creates incentives for Auction Keepers (external actors) to step in and drive the system back to a safe state (system balance) by participating in both debt and surplus auctions and, in turn, earn profits by doing so.” One way of keeping decisions in check was to automate them, and MakerDAO encoded foundational parts of its daily function into its protocol, bringing machines in as part of the decision network.

MakerDAO additionally maintained a set of checks and balances that involved the larger community of the DAO, which one core-unit member has described as such: Typically, proposals start in the forum off-chain, passes a vote off chain, then vote goes on-chain. Only on-

chain decisions have the power to change parameters in the protocol; off-chain discussions will not. Token holders can stop what they perceive as an unfavorable direction there.

But if there are enough on-chain decisions that most people in the DAO disagree with, it could eventually cause the core units, effectively the DAO workers to refuse to write the code to implement a change, as they have no mandate to do what the token holders say. If core units “go rogue,” then token holders could find new workers to update the protocol. But if token holders go enough against the interests of the DAO, everyone could choose to go elsewhere, or cause a critical mass of people to move to a different protocol, potentially even based on a fork, i.e., a copy of the same MakerDAO protocol. In this way, while the on-chain voting process by token holders seems simple, in reality, for the DAO to maintain organizational stability, the votes should hold a balance with the opinions of the larger DAO community, many of whom are not token holders.

This dynamic was not settled within the DAO community. For instance, in a governance and risk meeting, one participant asked: “Do we want non-MKR-holders deciding things? I think skin-in-the-game is important. I am a bit skeptical about how the polls do not take MKR weight into consideration.” Another participant responded: “MKR holders are in theory incentivized to keep both Dai and Vault holders happy. If that happens in practice is another question.”

A vote delegate described MakerDAO activity as a blend of democracy and plutocracy:

“What’s special about MakerDAO is that we do have democratic things happening, and of course, since it’s essentially not a democracy, but a plutocracy, we have stuff going on-chain as well. So, you could think of this as like we have a House of Commons [off-chain decisions], which is some kind of democratic thing. And we have a House of Lords, which is essentially the thing that is happening on-chain.”

Even among token holders, members are aware that the voting system at MakerDAO was imperfect. A protocol engineering core unit member described the trend toward centralization:

“We have to deal with our eventual corruption. You know, just because we're a DAO doesn't mean, we're immune from centralizing vectors that will drive power into the hands of the few. That seems to be just human nature, right? So, figuring out how to have checks and balances around your organization [is important].”

MakerDAO members also noticed a trend once they introduced delegates, where delegates with high voting power had strong influence over the decision process, whereas in the past, smaller MKR holders used to vote more often. This trend has been ascribed to gas prices, as well as voting not being incentivized or reimbursed at MakerDAO, though there are members in the DAO who would like to address this latter problem as voiced by a current vote delegate:

“I would like to go into the direction where...there would be some kind of penalty if you're not using your voting power. And there are also other systems you could think of for basically taking fraction of the revenue that we have or of the profit that we have, and spread it out to the active contributors. There was actually a maker improvement proposal about this, but it got declined, I think half a year ago, basically by VCs, they didn't like it. But that was before delegation. So maybe now as we have delegation in place, it could be the case that if we rerun this initiative, it could pass. But there's not a broad consensus on pushing for this right now. Yeah, I mean, this is all going to this free rider problem, deal with it, the free rider problem is not going to get solved.”

At the time of this study, voter delegation had been introduced recently at MakerDAO where a member could choose to delegate votes to a formal delegate. While it had the effect of decreasing small token holder individual participation, it also allowed the DAO to become more productive. A current delegate reflects:

“I would say it's been an improvement, in that basic things like distributing payrolls no longer gets held up for weeks at a time. I would say it's made it easier to pass things, but with a smaller set of voices ultimately, which is both good and bad, right? It makes it easier to have direction.”

Another member of the protocol engineering core unit team described delegation as a good way to resolve the information overload that the average token holder had been facing:

“There can always be a better solution that comes along, but I think we've pretty much solved that. It's pretty clear that delegates are the way to go when it comes to voting. Individuals will not participate. There's just too much information to keep track of. So having professional delegates is, I think, that's just a solved problem now.”

Core units at MakerDAO are an additional way that members have been choosing delegates to make decisions on their behalf, for instance, entrusting a work group to take care of a protocol decision. One stakeholder gave an example:

“Let's say if we trust a source for information for Oracle whitelisting. Do we trust the source information [we used when] we voted on it 30 times? And the answer was always, yes, we trust them. Eventually, the responsibility was placed with the Oracle's core unit, to simply whitelist on their own. And so this is a typical case of decentralization, you just take something that was central, and you move it down in the organization.”

An interesting aspect of MakerDAO core units was that, even in this trusted relationship, they had loose affiliation with the DAO, and in one case was even its own separate legal company. The co-founder of this company explained the experience of becoming a core unit in MakerDAO as follows:

“Yeah, we start this company and then in three years, we also become a core unit. So I guess this just happens kind of, and so far, just works. This also is a nice thing about DAOs, they are open for a lot of different ways of working together and care mostly about the result, and not about how they exactly produced [the result].”

In summarizing the mechanism of *structuring ownership*, by *designing dual-value tokenization*, the DAO sets the stage for stakeholders to vote and earn through tokens, with tradeoffs regarding the long-term and short-term interests of the token holders. Dual-value tokenization *incentivizes engaged activity* on the part of stakeholders, who can profit personally from the growth and success of the organization, which rewards contributors in reciprocation. This tokenization model also leads the organization in *architecting decision networks* in order to balance the power of large token holders, enable other stakeholders to make substantial contributions, and give momentum to decentralized governance processes.

While whales accumulated tokens, the DAO established several approaches for making sure their voting power was held in check. This happened both by decentralizing decision making as well as through the innate dynamics of the DAO community, which retained the

ability to quickly fork to create a new organization if the whales pushed too far in an unpopular direction. *Designing dual-value tokenization, incentivizing engaged activity, and architecting decision networks* comprise the mechanism of *structuring ownership*, which explains the process by which DAOs baseline their stakeholder investing and shaping of the platform (see Figure 5). In particular, *architecting decision networks* provided critical technical and social foundation of the DAO, ensuring that the DAO operated with multiple diverse stakeholders contributing substantively. This polycentric dynamic enabled decentralized member actions, which enabled the collective to form, and is described next.

Harnessing Collective

The mechanism of *harnessing collective* explains how the DAO maximizes participation while maintaining the distinctness of stakeholders and reinforcing formal procedures. In this section, the three key themes of this mechanism are named and elaborated, with some illustrative examples from MakerDAO provided (see Figure 3 for an excerpt from our data structure).

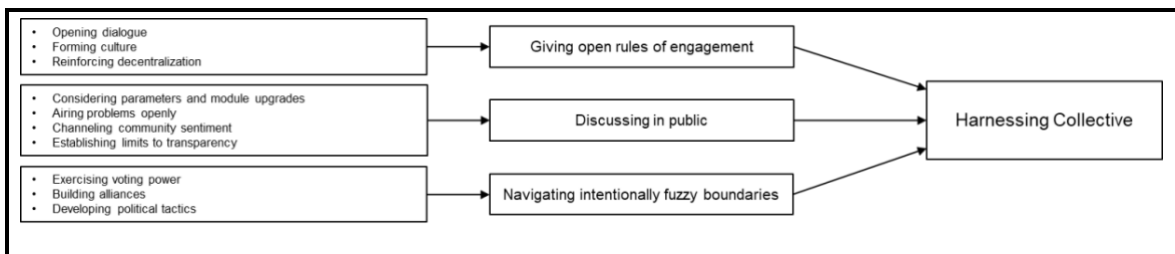


Figure 3. Mechanism of Harnessing Collective

Giving open rules of engagement: MakerDAO placed virtually no limits to whom may be considered a member of the organization, explained by the facilitator of the sustainable ecosystem core unit team as a strategy “to lower the barriers of entry for anyone that has a good idea to be able to come and execute,” including those with low or no MKR governance tokens. Despite having a formal on-chain vote eventually that would distinguish stakeholders who voted from non-token holders, who did not, members consistently reinforced the conviction that

anyone, token holder or not, could potentially impact the direction of the DAO. The facilitator of the governance communications core unit team described the open organization as such:

“Off-chain participants are anybody who voices their opinion or engages in conversation in one of our public venues. Whether it's the forum, whether it's our chat, whether you come on a public call, if you're participating in the conversation, you have a lot of influence.”

Much of the forum and chat discussions was recognized by members as signals for how the organization would move forward, despite occurring off-chain. One stakeholder explained:

“None of the polls we have are directly affecting the protocol. It's basically just giving the order of the mandate to the mandated actors or to the corresponding domain teams to act in a certain way. So for example, I'm part of the MakerDAO Open Market Committee, [and we] propose new parameters in terms of stability fees, or debt ceilings, or a lot of parameters, essentially. We meet once a month, and we do a proposal on the forum. There's a tiny fraction of nerds like me who like that stuff. Most of the people are interested in the broader, more strategic things, [such as] economic activities around green energy to prevent climate change.”

Through open dialogue in MakerDAO, many top contributors got started as users with opinions, as described by this same stakeholder who eventually became a recognized delegate:

“Essentially...they get adoption by users. And then a user starts contributing by at first, opening up a back ticket, or improving the documentation. And at some point, they even start doing pull requests by implementing their own features, for example. This is essentially what's happening with MakerDAO from my point of view, as well. A lot of people who are actively engaged with governance right now have been users two years ago. Which is great, I think, because then you learn along the way, the whole experience, not only from a governance perspective, but also from a user perspective.”

According to another stakeholder, the main limit to this open dialogue was not barriers to participation, but the DAO's complexity and the learning curve to understand how to contribute:

“It's not so easy to just be someone who has a great idea and then come in and contribute to Maker. And that's also because a lot of the governance processes that we can also get into today are kind of complicated. And that's inhibiting new contributors to come in.”

As dialogue ran open in the DAO, attention was placed in parallel into how to form a culture to contain it, as described by one of the facilitators of the governance core unit team:

“It's very hard to create a culture obviously. Hard to maintain it even. But what is really interesting and what kind of drew me in, it's a culture where criticism is welcomed and accepted, where we want people to try to point out flaws with thinking so we can end with the best result. There's always differences of opinion of how to do stuff, and what to do and how to react and what we should be focusing on. And a whole host of things. Part of my job is to try and make sure that people can have room to disagree without those disagreements spiraling into something that would become a community split.”

A member of another core unit team described MakerDAO's culture similarly in that “very early on, we tried to really establish this strong culture of what we call scientific governance.” One of the facilitators of the governance core unit team described their culture of “scientific governance” as follows:

It is this idea of, by challenging ideas, by bringing forth the problems with a new proposal, we can eventually get a better proposal from it, right. I'd say that the culture of Maker is really strong and really interesting, just in terms of the social dilemma problem, because it also has this kind of opposite effect, where also people are encouraged to pitch ideas, because we're so willing to engage with ideas and talk about problems we see with them. It also means it's a free ground to present counter narratives or alternative ideas. So, while that does split up energy, it does maybe limit the amount of things you're able to get done. Because so much of your social energy is spent deciding what path to walk. I think it often allows us to move slower and in a stronger direction.”

In contrast, another stakeholder perceived that all DAOs function, in reality, in a more primitive way, emphasizing that “crypto is tribal” and anticipating that delegates would become the new “chieftains.” Whether the culture was tribal or based on scientific governance, it appears that forming culture was an important component of the DAO platform, serving as it does in traditional organizations, as social cohesion for the collective.

Interestingly, this culture also reinforced decentralization, from what members described. One aspect was the nature of decision-making at the DAO. Since all decisions were given to the full group of token holders, a former vote delegate spoke about needing to take a minimum of 10 hours a week just to understand what was happening at the DAO:

“The token holders often are exposed to more or less the raw information of the organization. And that means that some of the questions whether they have to do with smart contracts,

smart contract verification, or Oracles or structuring of real-world assets, they are really, really abstract and you need to be both knowledgeable and smart. And concentrate and have the time for it in order to have a qualified opinion.”

Decentralization was maintained not only in the decisions made by the voters, but also in the work done by the core units. As one of the governance core unit team facilitators described:

“Something that's interesting is how the direction and efforts [of the DAO] are determined. Because you kind of have this sort of coyness. It's not really clear what core units are supposed to do what they think is best for the Maker Protocol, or do exactly what governance wants them do. And in practice that doesn't tend to be a problem, right? For example, for protocol engineering, no one's explicitly ever told them that they need to focus on building layer two solutions. But they're doing that, and spending a lot of time on it, because they're essentially the experts. And they know we're going to need it at some point. How people choose what to do is very much decentralized in that, a lot of the core units focus on what they think makes most sense.”

Through welcoming actors from the periphery into substantive, influential dialogues about the future of the DAO and developing an inclusive yet stimulating culture that reinforced decentralization, *giving open rules of engagement* appeared to be the outcome of *architecting decision networks*, which provided a strong foundation for such activities (see Figure 5).

Discussing in public: Open rules of engagement with incentives to participate led to lively discussion about DAO activities. For instance, DAO members might engage in discussion about encoded parameters to configure smart contracts: adding a new collateral asset type with a unique set of risk parameters, changing or adding risk parameters to existing collateral asset types, or modifying the DAI savings rate. They might also decide upon more complex upgrades to the DAO, according to the protocol:

“Other components of the system, such as auctions, oracles, and rate accumulators, are subject to future development. Their business logic has been contained within their own smart contract modules as an upgradable interface between the user and the Vat [smart contract]. Since these subsystems have access to more complex operations within the Vat, module upgrades are voted in by MKR holders.”

As a regular matter, the forums were often used to channel community sentiment about virtually any DAO topic, before deciding to make the substantial commitment of work to

advance an on-chain proposal. MakerDAO did this with an open process they called a “signal request,” which anyone could create and where anyone on the forum could vote, with or without tokens. One stakeholder gave an example of a signal request⁹:

“What a signal request is, we’re trying to gather a signal in the wider Maker community. There’s a signal request about increasing the surplus buffer, that’s really the Maker treasury, you could call it. So right now it’s set to like 60 million DAI, that’s the amount of DAI that we want to accumulate a sort of a stop, if there’s like market crashes, or something like that. There’s a vote to maybe increase this for various risk reasons. Here, he [the requester] outlines a lot of information, thought process behind this request, and some pros and cons. But then there’s essentially just like a forum poll here. And anyone can vote.”

Another core unit member described a range of discussions that they believed were good to have in public in the DAO community, but did not need a decision involving a smart contract change:

“If we talk about this recent example of, for example, Rune [the founder of MakerDAO], who was posting this huge vision mission statement for MakerDAO, like a 50-year vision, and you want to just gauge the community sentiment around some of the things. You can also use governance votes, but it’s a whole different thing, right? It’s completely different compared to changing on-chain parameters. Similarly, if we talk about onboarding a new team to MakerDAO, you don’t necessarily need to change any smart contract, you just want to have a democratic process to seek consensus around this certain question. And the outcome is handled off chain, not on chain.”

The collective participants of MakerDAO also talked openly about many different problems with the DAO in public, airing these problems openly for anyone to see. In fact, this has often been the basis of one person’s path from being a user to a delegate or core unit member, as one current vote delegate described:

“I just started getting involved in the forum. And, you know, just, I’m neurotic enough that when I saw things that needed to be fixed, I voiced my opinion, you know, it just kind of snowballs from there, and you get more and more involved.”

On the MakerDAO forum, there has been open discussion criticizing the work of one of the core unit facilitators, and calling to replace this person in order to preserve the core unit team. One core unit member commented about this contentious public discussion:

⁹ See, for example: <https://forum.makerdao.com/t/signal-request-increasing-the-surplus-buffer-2021-11/11448>

“That’s one of the things, when everything is so transparent, like, how is that handled when someone could technically get fired in a normal organization? That’s something that would be very...people wouldn’t be very vocal about and it would happen behind closed doors. And these things, it’s like a reputational thing. But here [at MakerDAO], we have to sort of do it out in the open. So there’s a lot of interesting comments in there. And yeah, I think it showcases what transparency also means in this regard.”

Talking about firing someone in as a public matter was an extreme case of the types of discussions the DAO members described happening in public. There have been debates, also in public, about whether such matters should remain public, and where to draw the line. Even though the blockchain that DAOs are built upon are touted as “trustless,” the MakerDAO members described highly social processes that require establishing trust across the community. Transparency was a way of building trust, to a certain extent, explained one of the governance core unit facilitators:

“Transparency is a big thing, just in general. But also, being transparent is quite a lot of work. Maybe the most unique thing is how much and how to communicate things to the rest of the DAO to the rest of the community. And whether that should be done more or less, how involved that should be, whether we should have meetings, which are not recorded or not published, whether we should have meetings that are open. This sort of stuff can sometimes cause contention as well. Well, I mean, a lot of things are public. Not everything’s public.”

As much as they conducted business in the open, as MakerDAO grew, members described the need to consider establishing limits to transparency.

Navigating intentionally fuzzy boundaries: With the forums including everyone who wished to give an opinion, join a discussion, and even vote in signal request polls, the members seeking to initiate change must navigate a chaotic environment with fuzzy boundaries that bar no one from participation. Yet this chaos was intentional in that it appeared to maximize participation in the DAO, which helped address free-riding in the collective. One way that token holders could redraw a crisp line of authority in the organization was by exercising their voting power. As has been described earlier, increasingly, token holders relayed their tokens to trusted

delegates, so that they did not have to spend as much time following proposals and projects. This decision to delegate tokens can be reversed as desired, as described by one core unit member:

“If someone disagrees with these delegates, they can remove their voting power from them immediately, like at any time. So we’ve actually seen, [one delegate] had at one point 22,000 MKR. But then some MKR holders didn’t like the direction he was going, he was working with a lot of official regulators in the US. And they didn’t really like how he was pitching Maker to lawmakers. He actually lost 15,000 MKR. And like voting power, so it can happen.”

Furthermore, members can create proposals to be voted on-chain that affected how day-to-day work was done at MakerDAO in the core units. One core unit facilitator explained:

“Someone can basically make a MIP [maker improvement proposal] to offboard us if we don’t do our job, fair enough, or to substitute us. Or we can do a MIP to maybe increase the team size. And then clarify why we need more people or more money, or whatever.”

Though there are many checks and balances in the DAO decision networks described earlier, exercising the voting power inherent in holding tokens at key moments can be an obvious way to change the DAO.

Members without tokens were required to take a more circuitous path towards initiating change, and did so by building alliances. One level of such alliance was gaining traction for an idea through the forums, as described by one stakeholder:

“Technically anyone can come and propose things to Maker, you don’t even need to have any MKR. It’s more about gaining traction behind your idea. I’d say without any MKR it’s more about influencing and like bringing opinions to the surface and persuading them. And we’ve seen that that is actually very influential because most MKR holders, they don’t really follow what’s going on in the forums that much, because there is a lot. So they will mostly delegate the MKR to delegates or just kind of follow what has been sort of gone through these first signal requests and then polls. So as a community member, you can actually come in and have a pretty big influence on what will make it to the final executive votes by participating in this process.”

A next level of alliance could include gaining buy-in and motivation from other teams, explained by the facilitator of the development & UX core unit team, who would like to implement changes that would decrease the cost of participation in governance:

“If you want to get something off the ground, that does not only involve your own team, but also other teams, then you actually need to find a way to motivate them. You need to build consensus around what you're doing. So it's a very democratic process. ... And I don't have any explicit power over them to say we need to start working on this. So I'm happy to see the engagement on the post [that he posted in the forum]. ... But it's really difficult to commit to a certain solution and then just start to work. I'm still not sure how I'm going to initiate that.”

These accounts from members detail both the promise of initiating change because of the openness of participation, as well as the difficulty of following through with any change because of the lack of specific authority and power, particularly for those who did not hold tokens.

Many participants in DAOs used pseudonyms, a common practice in blockchain work. In a striking turn, masking of identity has been employed in the development of a few political tactics at MakerDAO. At the time of writing this paper, MakerDAO's delegate page listed a total of twenty-one delegates. Nine of these delegates were labeled as “recognized” delegates and go by either pseudonyms or LLC company names. Twelve of these delegates were “shadow” delegates listed only by the title “Unknown” and collectively holding an accumulated 20,482.74 in delegated MKR tokens, or about 21% of the total delegated tokens. Given that much of the decision-making power has gravitated toward delegates, once formal delegates were recognized in the DAO, this was not a trivial amount. It is not clear why delegates would want to operate in fully anonymous status, and even less known why token holders would want to delegate to them.

In a similar vein, anonymous accounts have been used in the DAO forums, as described by the facilitator of the sustainable ecosystem core unit team:

“What I'm seeing is a lot of anonymous accounts popping up in the forum, which clearly has a lot of knowledge about Maker. And then he's very detailed, with the right vocabulary and all these traits that indicate that it's someone with another account, that they are not using their real name. So this is a discussion that we always have, for me, I think we need to develop something to make sure that that feedback, or those critics are being voiced in a way.”

It is perhaps inevitable that in an organization so radically transparent that some members would choose anonymity as a political tactic to leverage their interests in the DAO.

In summarizing the mechanism of *harnessing collective*, MakerDAO sets the stage for collective action by *giving open rules of engagement*, where open dialogue, culture formation, and reinforcement of decentralization take place. The open system of participation results in members *discussing in public* core organizational matters among diverse stakeholders, regularly channeling community sentiment. Building alliances and developing political tactics can influence the direction of the DAO, by non-token holders and even anonymous actors. Both open rules and open dialogue create an environment where participants *navigate intentionally fuzzy boundaries*, embracing the opinions of all stakeholders, yet with a common recognition that at any point formal voting power can be exercised, which keeps token holders distinct from other stakeholders and ultimately reinforces the formal on-chain process of the DAO (see Figure 5). As DAO members navigate these boundaries, this constant activity is the context through which the DAO moves towards the governance of its protocols, which is discussed next.

Governing Protocols

The mechanism of *governing protocols* explains how DAOs make key decisions regarding the evolution of the protocols while ensuring automated processes reflect interests of the collective, reinvigorating the decentralized aspect of the commons as it centralizes its governance. In this section, the three key themes of this mechanism are named and elaborated, with some illustrative examples from MakerDAO provided (see Figure 4).

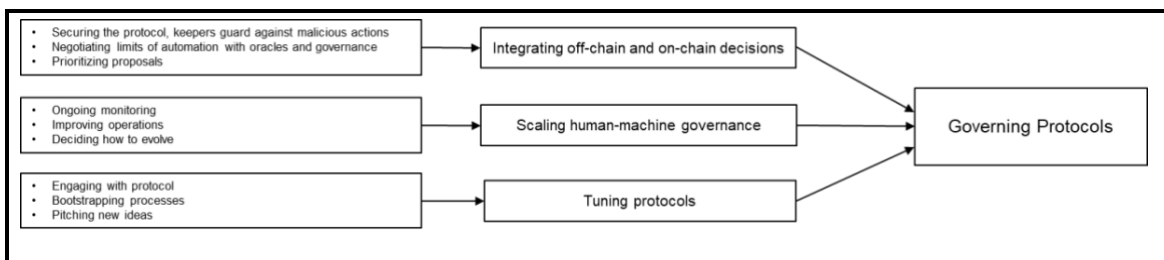


Figure 4. Mechanism of Governing Protocols

Integrating off-chain and on-chain decisions: MakerDAO members pointed out that the initial protocol itself was not the only value created by the DAO. Unique choices that MakerDAO made to adapt to environmental changes and making it safe also created value. One of the governance core unit facilitators explained:

“A basic system of the original DAI [can be] working in like a week or two, because you know, getting the basics like for making it function isn't that hard. But actually making it safe, making it reliable, and making it resistant to all sorts of different attacks is the brand, is where the value of Maker is.”

Some of the smart contracts implementing safety measures included: “chief-keeper,” which guards against malicious governance actions; “Vat,” which relies on a set of trusted oracles to provide price data; “Cat,” which identifies threats to the safety of vaults, and sends those with unsafe positions into liquidation; and the “System Stabilizer Module,” which corrects the overall MakerDAO financial system during times of volatility. One core unit was primarily tasked with securing the protocol, as explained by a protocol engineering core unit member:

“Yeah, our mandate is to basically secure and grow the core protocol. We're dealing with the central smart contracts that are mission critical for the operation of the Maker protocol. So we do audits and reviews and just make sure everything that's being added is top notch basically.”

This attention to security was interconnected with off-chain decisions made by the community so that the resulting on-chain protocol development could be said to have been integrated with these off-chain discussions. This member’s perspective about the philosophy of “strategic patience” that the facilitator of the governance core unit shared seemed particularly useful in describing how the DAO culture has affected how it has secured its protocol over time:

“One kind of interesting thing about Maker is, it's kind of designed to be slow, in many senses around the governance process and around just our culture for sure. Funneling ideas and engaging with them. So well, it's definitely a problem. In many cases, the bottleneck is the social layer. It also, I think, ultimately produces better work at a slightly slower rate. There's kind of a meme, for lack of a better term, within the community. We say it's 'strategic patience' because often things are just so slow. Obviously, people will talk about the Black

Thursday incident. And even then, we really switched up and learned from it and released a new liquidations method because of it. So we kind of have this chip on our shoulder of being a protocol that hasn't been hacked and not wanting that to change. We wait on audits, we wait on reports from all the core units. It has to go through a few rounds of governance votes. We still have this kind of slow played out governance process combined with like, really strong critical checks on our code, that ultimately do make things slower."

Another way that off-chain decisions have been integrated on-chain was how MakerDAO as a collective intentionally decentralized its network through redundancy in order to increase its resilience. According to one member of the collateral engineering services core unit:

"Yeah, I think the main point is resiliency. We have this decentralized protocol, decentralized system. We actually want to sort of have multiple parallel teams working on the same things, because if one team is shut down for legal reasons, or other reasons, then the project will still live on. That's kind of the same as sort of the underlying infrastructure of Ethereum, which is like this decentralized network. If there are certain nodes running in the network they shut off, then the network will still continue, because there's still other nodes running. So it's not like a centralized system that you can shut off. And that's what we're trying to achieve on the organizational point as well that we don't want a central point of failure in this decentralized organization. So that's like one part of it, we also think that we can achieve a lot more scale."

In a sense, integrating off-chain and on-chain decisions is about negotiating limits of automation, where technically automation can persist but would eventually devolve without the human participants, as explained by a recognized delegate who participated in many voting decisions:

"The whole protocol is a protocol on the chain. So, it's only the governance perspective that can be influenced by humans. Okay. So we can decide on parameters, we can decide on funding for teams we can decide on even defunding teams, so getting rid of somebody who is not behaving in a good way. We can decide on are we willing to investigate on a special integration with a different partner, for example, but the product itself is completely on chain. And it's just about basically turning some knobs and adjusting some parameters, which is then enforced by governance. But if all of us would stop working right now, then the whole protocol would still carry on, those fees would probably at some point of time be off the rest of the markets or ahead or behind competition, for example, but the protocol itself is unstoppable already."

In a few extreme cases, MakerDAO provided means for emergency shutoff of its smart contracts and encodes requirements for human interventions. One example was that "Emergency Oracles" may pre-emptively shut down price feeds as a protective measure, but the oracles were

prohibited from bringing the price feeds back up. Instead, human governance must take place to restart activity. Additionally, MakerDAO has established governance processes to both enable and disarm emergency shutdown as described in the protocol documentation:

“If governance wants to disarm the ESM [Emergency Shutdown Module], it can only do so by removing its authorization to call `end.cage()` before the ESM is triggered. The delay would give MKR holders the opportunity to protect the system, if necessary, against a malicious governance proposal (e.g., a proposal that alters collateral parameters contrary to established monetary policies or that allows for security mechanisms to be disabled) by triggering a Shutdown.”

As it is recognized that humans must continue to be involved in developing the organization, MakerDAO participants have developed what they refer to a continuous approval system, a key mechanism by which the DAO systematically prioritized proposals. The basic rule was that the number of token votes for any new executive proposal must surpass the previous proposal vote in order to get voted in. This automatically sorted and queued up the most supported proposal being considered at any given point to be enacted on-chain. After forum discussion, signal requests, and formal polling, this point in a proposal’s evolution in the continuous approval system was definitive in moving it from off-chain to on-chain.

Scaling human-machine governance: As we interviewed MakerDAO members, we were guided to several public web pages where the DAO monitors itself, for instance, tracking distributions of DAI from the protocol to core units. There were financial and accounting trackers examining internal flows and market prices, tracking on post comments and post writers, delegate metrics and voting history, and member protocols. This ongoing monitoring supplied a steady information feed that generated the community discussion, leading to polls and proposals.

Against the backdrop of this stream data, MakerDAO members made a series of operational improvements that have lessened the friction of participation. One example was given by a former vote delegate:

“If you go back, let's say six to nine months, we were voting on every single parameter change, every single one. And after a while, it became clear that this was a complete waste of time.”

Another change was to bundle proposals to save on the cost of gas as described by the facilitator of the governance communications core unit team:

“Now you don't have to vote on each individual proposal. You could actually set up, like, a whole ballot. So if there's 15 outstanding votes, you could vote on all 15 of them in one transaction. Also between 50 and 250 dollars, based on gas.”

The introduction of delegation was cited by several members as an important way of speeding DAO activity. MakerDAO members also implemented automated modules to supply budgets to core units, also improving overall productivity.

Working groups and committees pored over the finer details of stability fees and made parameter proposals, saving time for others who would rather focus on larger strategic questions. These larger strategic questions involved how the DAO was to evolve. One question was how to characterize work and engage workers in the DAO, as described by one current vote delegate:

“Core units are some weird hybrid of employees and contractors that directly provide services to the DAO in exchange for compensation. And so in theory, they work for the DAO. In practice, a lot of those people are themselves Maker holders as well. And over time, many of them will also get some Maker [tokens] from vesting as part of their compensation. I dislike how it's ambiguous about whether they're contractors or employees, I think some of them are more of one than the other. So we're still kind of sorting through that.”

There was a running debate about whether MakerDAO should continue its decentralized operations or mature into a more traditional style corporate organization. Here was one stakeholder on the side of staying decentralized:

“I see a growing decentralized organization, [that] needs to work like a terror network, basically of autonomous cells that are totally capable of doing whatever they need to do to fulfill that mission. So like a self-sufficient, self-sustaining, totally capable, autonomous organization, which is small enough to deal with all the stuff they need to without increasing some kind of hierarchy. I think that's the preferred model of moving forward.”

Here was another stakeholder, also member of a core unit, on the side of adopting some norms of traditional organizations:

“I think Maker holders, even now, are probably just voting on too small of details. I think there should be more delegation of the delegates to the core units and stuff like that, to basically get more autonomy and be like, you know, we trust you guys know what you're doing. You know, it's not just free rein to do anything, but with some, maybe more account or auditability, to within the core units, basically, more autonomy to basically call the shots. It's more how traditional corporations work, right? The shareholders don't vote on every small little thing. They vote to empower a small management team or whatever, to figure out the day-to-day operations. And I think we should emulate that a bit more. Yeah, there's all kinds of aspects to scaling governance.”

As MakerDAO scaled, many organizational questions opened, requiring thoughtful deliberation on how the organization was to grow. Ongoing monitoring brought big questions to the surface, which spurred operational improvements and debates on how the DAO should evolve.

Tuning protocols: While some members looked deeply into governance matters or looked far ahead to the future of the DAO, other members were primarily engaging with the protocol, as the facilitator of the governance communications core unit team described:

“For integrators and partners, I would say that, technically, once they're set up, really their touch point is on the protocol level. ... They interact with the people who are on the protocol, or the people who are involved with the operations of the protocol, only for the setup, the maintenance, and then if there is offboarding, some sort of offboarding process.”

Another group focused on stabilizing the match between the value of DAI, MakerDAO's cryptocurrency, with the US dollar, which defines DAI as stablecoin, as explained by a member of the collateral engineering services core unit:

“We would have working groups that, you know, literally only look at, what is the DAI peg? They would look at something like dai.stablecoin.science. I think this one aggregates like a lot of data from different exchanges. For example, there's this maker.blockanalitica, that's maintained by our risk team. There's a lot different things to look into here. But it's sort of scientific [in] that, if DAI is trading above the peg, we're not just gonna mint unbacked DAI or something like that. We will look at the data of different collateral types and figure out how can we tweak the risk parameters in a way that, we can see in our models here that, that it will increase the DAI supply through DAI generation, and these kinds of things. So, I mean, it's mostly just rooted in the fact that we base our decisions on models and data.”

Working deeply in the protocol led core units to find ways of bootstrapping processes, or slowly building up an aspect of the organization to a desired state. On a discreet level, this could happen in a single process, as described by a core unit facilitator:

“With Oracles, we introduced a whitelisting system. They actually have to reach out to our Oracles team, and notify us that they want to use them. Eventually, there will be a more streamlined process for that, but at the moment, yeah, we're kind of doing it that way.”

Another core unit was exploring how to improve overall user experience associated with MakerDAO governance, as the facilitator explained:

“My core unit is called DUX, which stands for development and UX. We're kind of like a more generic design and development team that is currently focused on everything related to governance. For example, we have built and are maintaining the MakerDAO governance portal. But we're also looking into how can we improve the UX of participating in governance as a whole. Over time, we hope to expand that mandate also to other front ends.”

On a more expanded level, the DAO established an incubation program to support newly formed core units. This attracted a group to work with MakerDAO over other DAOs as the facilitator of the newly incubated core unit team described:

“Shortly before we started, the incubation program was just established. We were also bit of guinea pig for that thing, right. But we basically asked in different firms, not just at Maker, so we wanted to contribute to some of the DAOs. And Maker just had the most structured approach for newcomers, in my opinion. In the beginning, I kind of thought, ‘Okay, why do we need this very long incubation program? Can we just like agree on a topic, write the MIPs [maker improvement proposals], and then start like, basically as a core unit?’ But afterwards, after running through it, I can say that it made a lot of sense to really reach down [with] what we're going to do, how it's useful for a DAO and really understand all these connections before we basically commit through the MIPs for a long time to work on a certain topic.”

Those members focused on the protocol level were positioned to pitch new ideas for specific, targeted protocol solutions. The facilitator of the governance communications core unit team described a symbiotic relationship between core units and external stakeholders of the DAO:

“I am 100% certain that auction participants, collateral partners, they also have direct lines of communication with various core units for advisement. So core units really are kind of like

subject matter experts. And so yeah, those direct lines of communication are also there. And in response, core units will make recommendations based on like, what their stakeholders are telling them. So if the Oracles core unit is kind of like the main line of communications for Oracle users, they will be the ones to try to relay that feedback.”

A former vote delegate described a module that has been developed that could someday remove human governance activity associated with particular parameter changes:

“It’s a small program. It’s just like a button on a stereo. So you go into the contracts, and you access the Instant Access Module and you tweak a certain parameter. And, here’s the thing, so it’s just like that, in that way, anyone, absolutely anyone can influence a parameter in Maker governance. First of all, it removes the human or centralized humans out of the equation. And also, it potentially allows for more substantial changes to be made if you allow staking to be included in the Instant Access Modules. So Instant Access Modules have great potential for the future. But so far MakerDAO has not had the guts to try this on a more advanced level. Certain amounts of parameters could very well be made governance-free. If you have the financial initiative to change a parameter, and you’re willing to stake money on the outcome of that fight, go ahead.”

In summarizing the mechanism of *governing protocols*, as stakeholders navigate multivocal and dynamic politics, the organization eventually converts its collective dialogue, *integrating off-chain and on-chain decisions* to inform automated process. This integration spurs both lower-level problem solving and big-picture thinking by participants. With *tuning protocols*, stakeholders solve discreet problems and bootstrap processes to develop the organization incrementally. This ongoing progress supports larger change, where in *scaling human-machine governance*, stakeholders focus on the long-term evolution and growth of the organization. Attention to the large-scale evolution of the organization regenerates and refines the process of *architecting decision networks*, which is how the mechanism of *governing protocols* interrelates with the mechanism of *structuring ownership* in the DAO (see Figure 5).

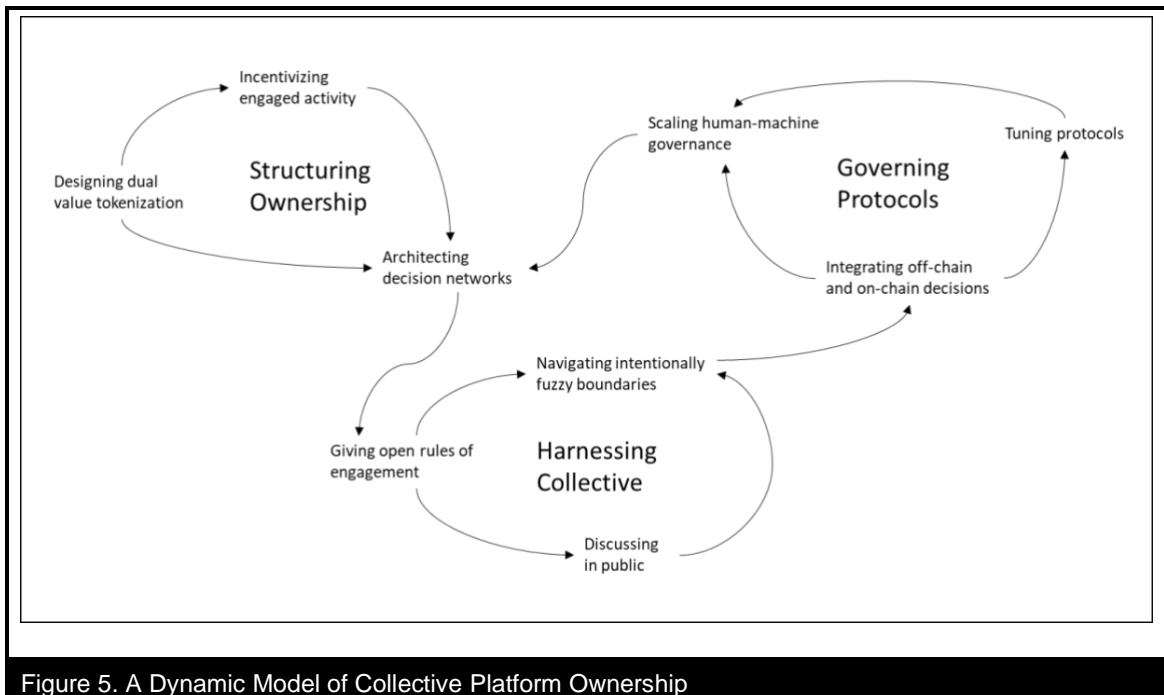


Figure 5. A Dynamic Model of Collective Platform Ownership

DISCUSSION

A Dynamic Model of Collective Platform Ownership

Based on our findings, we propose a dynamic model (Figure 5) that demonstrates how the dynamic interplay between the mechanisms of *structuring ownership*, *harnessing collective*, and *governing protocols* in decentralized platform governance facilitates the collective action that is needed to create and sustain the DAO. This model explains collective platform ownership, in contrast to central ownership assumed in prior platform literature. In decentralized platform governance, in contrast to an owner developing the governance framework (Brunswick et al., 2019; Tiwana et al., 2010), it is the participants who both use the platform and develop its governance. The separation of and asymmetry between platform ownership and platform participation are reduced where the model of collective platform ownership is applied when participants have *skin in the game*. Rather than a dominant platform with centralized governance (Foerderer et al., 2018; Huber et al., 2017; Tiwana et al., 2010), participants collectively own the

platform, make decisions about how to develop the platform, and monitor its activities and environment. In decentralized platform governance, non-focal actors may still have an influence on how the platform functions.

In addition to executing decentralized platform governance, our proposed model also describes how the DAO functions as polycentric commons (Mindel et al., 2018; Ostrom, 1990). The underlying resources of the DAO commons are its tokens, smart contracts, and protocols that are open-source, shared, and collectively owned and managed as highlighted by the interplay of the three identified mechanisms in our model (see Figure 5). Diverse stakeholders and processes of dialogue create multiple independent human decision-making centers. Whales provide capital, usually disengaged in the forums but occasionally stepping in to influence profit-protecting activities. Delegates invest time in careful consideration of proposals and fast-moving markets, amassing community trust to lead voting measures. Core unit members carry out the work that has been mandated by the community. A wide swath of active participants, with and without tokens, operate in the forums to influence all aspects of the organization and how it prioritizes proposals.

Through the interplay of collective platform ownership mechanisms, a polycentric structure emerges where people coordinate and govern in a DAO, addressing collective action problems. As we have described, *structuring ownership* explains how baselining stakeholder investing and shaping of the platform enables decentralized member actions. *Harnessing collective* explains how participation is maximized while aiming it toward structured processes, enacting a recentralization of focus and direction in the organization. *Governing protocols* explains how decisions are made regarding the evolution of protocols while ensuring automated processes reflect interests of the collective, reinvigorating the decentralized aspect of the

commons as it centralizes its governance. We extend the work of Elinor Ostrom (2000, 2008, 2010) by suggesting that the polycentric commons of DAOs operate in an environment of constant flux, rather than through a stable arrangement of known actors. Whereas trust is important to previous conceptualizations of the governance of the commons, DAOs operate in a trustless, smart-contracts based arrangement. While previously, increased numbers of actors made it more difficult to govern the commons because of the costs of complexity, DAOs give the opportunity for the commons to scale successfully. In the DAO configuration of the commons, more engaged actors in the DAO increase the potential for the organization to succeed in its goals, thus size is not a problem.

DAOs have some interesting things to say vis-a-vis the polycentric commons, particularly when it comes to the principles of well-defined user boundaries, conflict resolution mechanisms, monitoring and decision-making (Ostrom, 1990, 2008). Regarding user boundaries, the polycentric commons are typically associated with “clear and locally understood boundaries between legitimate users and nonusers” (Ostrom, 2008, p. 12). In one sense, in DAOs, holding tokens are a new, particularly distinctive way of defining a boundary in the polycentric commons, as only token holders can vote on-chain – this sets DAOs apart from information commons where the boundaries are set by rules and centralized infrastructure (Mindel et al., 2018). At the same time, successful DAOs are much more than the sum of their tokens, and we have seen in our study, part of their success lies in the fact that their boundaries are intentionally fuzzy. This relative boundarylessness serves to replenish activity in the commons, as the actors in the periphery, in diverse and bountiful groupings of stakeholders, are continually drawn inward to contribute meaningfully to the DAO.

Regarding conflict resolution mechanisms, according to Ostrom (2008, p. 15), “rules unlike physical constraints, have to be understood in order to be effective.” According to our study, DAOs work with rules in the polycentric commons in a novel way. Smart contracts, as a type of rule, do not have to be understood, essentially functioning as a de facto physical constraint, allowing and disallowing actions across the DAO. However, there is usually a highly social process prior to an on-chain decision where understanding is formed in the collective. And yet, the release of any possible physical constraint retained through smart contracts is merely a vote away by the DAO token holders.

Probably the most significant novelty that DAOs offer to Ostrom’s concept of monitoring and decision-making in the polycentric commons (Ostrom, 1990, 2008) is that non-human decision centers are included. Monitoring and the resulting decision-making is done well by machines, arguably in some cases better than their human counterpart, in their consistency and reliability. This fact upends the conventional ideas of trust and reciprocity in the polycentric commons (Ostrom, 2008) or peer monitoring such as mutual ratings and rankings (Mindel et al., 2018). Monitoring and decision-making by smart contracts in DAOs encode human trust in the organization, in that they allow actors to trust other actors they don’t know. To wit, many actors in our study are anonymous or pseudonymous, known only by other actors by their handles, in the forums, and even in on-chain votes. They will likely never meet in person. In other words, blockchain extends trust, scaling trust to even extend to strangers, in the polycentric commons.

Theoretical Implications and Future Research

Our research offers theoretical contributions and implications for research on platforms, including their governance and evolution, in the context of the rise of DAOs.

Platform Governance: Towards Polycentricity

Our contribution to the platform governance literature (e.g., Tiwana et al., 2010) is a dynamic model of collective platform ownership. The model consists of three polycentric governance mechanisms that help theorizing the governance of DAOs, an emerging category of decentralized platforms that has received little attention in the platform literature (Chen et al., 2021). While the extant platform literature exhibits centralized platform ownership assumptions (e.g., Constantinides et al., 2018; Foerderer et al., 2018; Tiwana, 2015), the rise of DAOs and the associated shift towards collective ownership explained through our findings invites a fresh perspective on polycentric platform governance.

Our findings indicate that polycentric platform governance differs from the centralized platform ownership assumptions pervading the platform literature in several important ways. First, a key concern in centralized platform ownership is maintaining platform control while optimizing platform characteristics like openness to ultimately enable the central platform owner to capture more value (Eaton et al., 2015; Parker & Van Alstyne, 2018; West, 2003). The extant literature views complete openness, i.e., the absence of control at the platform level through the use of unrestricted open standards, as unfeasible and detrimental for creating and maintaining platforms (Boudreau, 2010; Cennamo & Santaló, 2019; Gawer & Cusumano, 2002; Parker & Van Alstyne, 2018). In contrast, polycentric platform governance as manifested in our empirical study of DAOs resolves such asymmetries and blurs the line between platform owners and users by instituting a new collective ownership model where everyone has some *skin in the game* (Taleb, 2018). As a result, risks *and* rewards are more equally (but not necessarily evenly distributed) shared among platform users, depending on their level of investment and involvement in the polycentric common (i.e., the DAO) through the available token-based ownership and collective governance structures (O'Mahony & Karp, 2020). Extending previous

platform governance research (e.g., Tiwana et al., 2010), our research suggests that creating and maintaining completely open platforms with a high degree of decentralization is feasible through polycentric platform governance (cf. Constantinides & Barrett, 2015; Mindel et al., 2018).

Polycentricity may mitigate problems of over-decentralization, where distributing governance too widely could stifle the momentum and speed of collective action (Chen et al., 2021).

Second, the extant platform literature views the alignment and coevolution of design and governance choices by platform owners as a critical success factor for sustaining and evolving the platform over time (Constantinides et al., 2018; Tiwana et al., 2010). This embodies the idea of fit between platform architecture choices and platform governance choices (Tiwana et al., 2010). In contrast, the focus of alignment and coevolution of choices in a collectively owned platform (i.e., DAO) is different and requires a new and complementary framework which we can derive from the theoretical integration of our findings with the theory of polycentric commons (Ostrom, 1990). Polycentric platform governance in DAOs involves the coevolution of collective ownership choices (see the mechanism of *structuring ownership*) with smart contract design (see the mechanism of *governing protocols*) and community engagement (see the mechanism of *harnessing collective*). The choices across these three layers of a DAO determine the platform's functioning and dynamics including the mutual adjustments of relationships among users as well as the governing algorithms which collectively shape the sustainability of the polycentric commons (i.e., the DAO).

Polycentric Governance Mechanisms

This study suggests covariance between collective action and decentralized platform governance. Just as the polycentric commons is a suitable lens to understand the contribution of decentralized governance to collective action, it also provides a means to better understand and

explain how characteristics of decentralized governance are distinct from centralized governance. In this vein, we extend the literature regarding polycentric governance mechanisms (Mindel et al., 2018; Ostrom, 1990) in two ways. First, the rules inherent in collective platform ownership go beyond that of a general system where independent actors make mutual adjustments (Mindel et al., 2018). In our case study, the rules are set in permissionless code, and actors work through intensive dialogue and decision-making processes to enact votes to further the commons. While the rules are more formally enforced in DAOs, these rules are also collectively shared and enforced collectively. Second, our model of collective platform ownership provides a pathway for polycentric governance to scale and remain deeply engaged with its participants. The combination of protocol automation with active community process, enabled by a decentralized structure, allows for many diverse types of actors to remain in the core of the commons, and not be relegated to its periphery, as the organization grows over time.

Overall, our model of collective platform ownership suggests a more fine-grained picture of how decentralized governance operates in DAOs. Rather than a simple decentralization scheme, the DAO is not fully decentralized, nor fully centralized, moving instead with a polycentric approach. The checks and balances inherent in its protocol and processes to enact the centralization-decentralization-recentralization dynamics that come into play as it performs its activities, where different types of actors exert influence at different stages of any decision made by the DAO. The reality that participants are more likely to succeed collectively forges what might have been independent actors, in a different and less collective system, into the strong tribal sensibility for which DAOs are recognized.

Directions for Future Research

Our findings lay conceptual foundations for examining the new platform-based dynamics of value creation and capture on top of the so-called *internet of value* (Lacity, 2020) and suggest the need to expand our vocabulary to theorize about platform governance dynamics in future research. In the context of platform governance research, a concept receiving considerable attention is *generativity* (Henfridsson & Bygstad, 2013; Tilson et al., 2010), defined by Zittrain (2008) as “a system’s capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences” (p. 70). While this concept has made important contributions to explaining exponential growth and digital innovation in platform markets (Huang et al., 2017), our understanding of societal change induced by digital transformation (Majchrzak et al., 2016) has benefitted to a lesser extent from this concept. To advance this important research agenda, the idea of *collectivity* may be added to the mix and vocabulary. Based on our observations, *collectivity* in the context of digital platforms can be defined as a system’s capacity to produce desired change through self-organized filtering of contributions from heterogeneous stakeholders. While generativity is associated with unpredictable change resulting from innovation (Zittrain, 2008); collectivity may be associated with desirable change resulting from collective action. Generativity contributes to our understanding of the dynamics of value creation and capture dominated and controlled by platform owners (Gawer, 2009; Gawer, 2014); collectivity promises to contribute to our understanding of the dynamics of democratized value creation and capture shaped by every platform user.

In prior research on work environments shaped by centralized platform governance, such as in the case of Uber, platform workers are viewed as a new category of labor that sits in between the conflicted middle between independent contractors and employees of a company (Moehlmann et al., 2021). DAOs as a new category of more decentralized platforms alter the

nature of work, creating a new work environment that is currently not well understood in the literature. We suggest future research to examine this new decentralized work environment, including not only the opportunities but also the tensions and unique challenges it creates, and how users respond to them. For example, a key tension seems to be between earning financial rewards and making sustained contributions to the DAO to enable its organizational functioning and scalability.

DAOs are part of a larger movement that involves a new wave of computerization. DAO experts refer to the crypto renaissance—if the internet of information is compared to the printing press revolution, the internet of value is viewed in terms of the double-entry bookkeeping revolution. In combination, the printing press and double-entry bookkeeping contributed technologically to the renaissance period involving an economic and wider cultural revolution. At the same time, movements based on cryptocurrency, such as the rise of DAOs, are occurring globally in an ambiguous legal context, and at such speed, to require the passage of time to fully understand their implications and role in society, for good or bad. Future research could examine the potentially transformative impacts of DAOs on a wide range of societal outcomes, spanning from financial and other types of inclusion to broader institutional change (Faik et al., 2020) including not only the banking sector but the nature of the firm more generally.

Our findings suggest that today's DAO experiments are not without challenges, including collective action problems such as whale dominance and voter apathy as a form of free riding. We suggest future research to shed light on the potential dangers, risks, and unintended consequences of this new development. Doing so would allow us to better understand whether DAOs in particular end up re-creating the same types of structures and conflicts of interest that characterize existing financial market infrastructure and banking systems around the world.

Limitations

Limitations of our study follow from the focused framing on DAOs and target contribution of a dynamic model of explanatory mechanisms to the platform governance literature. Our research and findings invite multiple angles on DAOs, each worthwhile exploring in greater depth than what we could do in a single paper. This study did not compare multiple DAOs to identify boundary conditions, contingencies, or environmental factors that could facilitate or hinder collective action. We viewed DAOs as platforms (e.g., MakerDAO as a platform connecting financial supply and demand in a decentralized fashion), and our focus of research was a mature DAO with a highly evolved governance structure. Many other DAOs exist in different stages of development and levels of success regarding their financial, social engagement, and organizational outcomes, and thus may yield a wide variety of insight regarding the use and impact of technology in this novel organizational form. DAOs and their technology-enabled governance mechanisms and infrastructures suggest new intellectual avenues to explore, for their potential to influence alternatives in corporate governance, to spur evolution in civic governance, and even to construct vehicles for societal transformation.

REFERENCES

- Afuah, A. (2003). Redefining Firm Boundaries in the Face of the Internet: Are Firms Really Shrinking? *Academy of Management Review*, 28(1), 34-53.
- Aligica, P. D., & Tarko, V. (2012). Polycentricity: From Polanyi to Ostrom, and Beyond. *Governance*, 25(2), 237-262.
- Andersen, J. V., & Bogusz, C. I. (2019). Self-organizing in blockchain infrastructures: Generativity through shifting objectives and forking. *Journal of the Association for Information Systems*, 20(9), 1242-1273.
- Barrett, M., Oborn, E., & Orlikowski, W. (2016). Creating Value in Online Communities: The Sociomaterial Configuring of Strategy, Platform, and Stakeholder Engagement. *Information Systems Research*, 27(4), 704-723.
- Beck, R., Mueller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. *Journal of the Association for Information Systems*, 19(10), 1020-1034.

- Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press.
- Birks, D. F., Fernandez, W., Levina, N., & Nasirin, S. (2013). Grounded Theory Method in Information Systems Research: Its Nature, Diversity and Opportunities. *European Journal of Information Systems* 22(1), 1-8.
- Boudreau, K. (2010). Open Platform Strategies and Innovation: Granting Access vs. Devolving Control. *Management Science*, 56(10), 1849-1872.
- Bridoux, F., & Stoelhorst, J. W. (2020). Stakeholder governance: Solving the collective action problems in joint value creation. *Academy of Management Review*, In-Press.
- Brunswick, S., Almirall, E., & Majchrzak, A. (2019). Optimizing and Satisficing: The Interplay Between Platform Architecture and Producers' Design Strategies for Platform Performance. *MIS Quarterly*, 43(4), 1249-1277.
- Bunge, M. (2004). How Does It Work?: The Search for Explanatory Mechanisms. *Philosophy of the Social Sciences*, 34(2), 182-210.
- Cennamo, C., Marchesi, C., & Meyer, T. (2020). Two sides of the same coin? Decentralized versus proprietary blockchains and the performance of digital currencies. *Academy of Management Discoveries*, 6(3), 382-405.
- Cennamo, C., & Santaló, J. (2019). Generativity tension and value creation in platform ecosystems. *Organization Science*, 30(3), 617-641.
- Charmaz, C. (2006). *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*. SAGE Publications.
- Chen, Y., Pereira, I., & Patel, P. C. (2021). Decentralized Governance of Digital Platforms. *Journal of Management*, 47(5), 1305-1337.
- Constantinides, P., & Barrett, M. (2015). Information Infrastructure Development and Governance as Collective Action. *Information Systems Research*, 26(1), 40-56.
- Constantinides, P., Henfridsson, O., & Parker, G. G. (2018). Platforms and Infrastructures in the Digital Age. *Information Systems Research*, 29(2), 381-400.
- Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed Tuning of Boundary Resources: The Case of Apple's iOS Service System. *MIS Quarterly*, 39(1), 217-243.
- Faik, I., Barrett, M., & Oborn, E. (2020). How does IT matter in societal change? An affordance-based institutional logics perspective. *MIS Quarterly*, 44(3), 1359-1390.
- Fisher, G., Mayer, K., & Morris, S. (2021). From the Editors—Phenomenon-Based Theorizing. *Academy of Management Review*, 46(4), 631-639.
- Foerderer, J., Kude, T., Mithas, S., & Heinzl, A. (2018). Does Platform Owner's Entry Crowd Out Innovation? Evidence from Google Photos. *Information Systems Research*, 29(2), 444-460.
- Gawer, A. (2009). *Platforms, Markets, and Innovation*. Edward Elgar.
- Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. *Research Policy*, 43(7), 1239-1249.
- Gawer, A., & Cusumano, M. (2002). *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation*. Harvard Business School Press.
- Gerring, J. (2006). *Case Study Research: Principles and Practices*. Cambridge University Press.
- Ghazawneh, A., & Henfridsson, O. (2013). Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model. *Information Systems Journal*, 23(2), 173-192.

- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods, 16*(1), 15-31.
- Glaser, B. (1978). *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*. Sociology Press.
- Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research* (1 ed.). Aldine Publishing Company.
- Gregory, R. W., Henfridsson, O., Kaganer, E., & Kyriakou, H. (2021). The Role of Artificial Intelligence and Data Network Effects for Creating User Value. *Academy of Management Review, 46*(3), 1-18.
- Hassan, S. (2021). Decentralized Autonomous Organization. *Internet Policy Review, 10*(2).
- Henfridsson, O., & Bygstad, B. (2013). The Generative Mechanisms of Digital Infrastructure Evolution. *MIS Quarterly, 37*(3), 907-932.
- Huang, J., Henfridsson, O., Liu, M. J., & Newell, S. (2017). Growing on Steroids: Rapidly Scaling the User Base of Digital Ventures Through Digital Innovation. *MIS Quarterly, 41*(1), 301-314.
- Huber, T. L., Kude, T., & Dibbern, J. (2017). Governance Practices in Platform Ecosystems: Navigating Tensions Between Cocreated Value and Governance Costs. *Information Systems Research, 28*(3), 563-584.
- Hukal, P., Henfridsson, O., Shaikh, M., & Parker, G. (2020). Platform signaling for generating platform content. *MIS Quarterly, 44*(3), 1177-1206.
- Iansiti, M., & Lakhani, K. R. (2017). Managing Our Hub Economy. *Harvard Business Review, 95*(5), 84-92.
- Kenney, M., & Zysman, J. (2016). The Rise of the Platform Economy. *Kenney, Martin, and John Zysman. "The rise of the platform economy." Issues in Science and Technology 32.3 (2016): 61., 32*(3), 61-69.
- Kraemer, J., & Schnurr, D. (2021). Big Data and Digital Markets Contestability: Theory of Harm and Data Access Remedies. *Journal of Competition Law and Economics, In-Press*.
- Lacity, M. C. (2020). *Blockchain Foundations: For the Internet of Value*. Epic Books.
- Lee, A. S., & Baskerville, R. L. (2003). Generalizing Generalizability in Information Systems Research. *Information Systems Research, 14*(3), 221-243.
- Lumineau, F., Wang, W., & Schilke, O. (2021). Blockchain Governance—A New Way of Organizing Collaborations? *Organization Science, 32*(2), 500-521.
- Majchrzak, A., Markus, M. L., & Wareham, J. (2016). Designing for Digital Transformation: Lessons for Information Systems Research from the Study of ICT and Societal Challenges," *MIS Quarterly, 40*(2), 267-277.
- Meyer, C. (2020). The commons: A model for understanding collective action and entrepreneurship in communities. *Journal of Business Venturing, 35*(5).
- Mindel, V., Mathiassen, L., & Rai, A. (2018). The Sustainability of Polycentric Information Commons. *MIS Quarterly, 42*(2), 607-631.
- Moehlmann, M., Zalmanson, L., Henfridsson, O., & Gregory, R. W. (2021). Algorithmic Management of Work on Online Labor Platforms: When Matching Meets Control. *MIS Quarterly, 45*(4), 1999-2022.
- Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2021). Contracting in the Smart Era: The Implications of Blockchain and Decentralized Autonomous Organizations for

- Contracting and Corporate Governance. *Academy of Management Perspectives*, 35(4), 622-641.
- O'Mahony, S., & Ferraro, F. (2007). The Emergence of Governance in an Open Source Community. *Academy of Management Journal*, 50(5), 1079-1106.
- O'Mahony, S., & Karp, R. (2020). From proprietary to collective governance: How do platform participation strategies evolve? *Strategic Management Journal*, 43(3), 530-562.
- Olson, M. (1965). *The Logic of Collective Action: Public Goods and the Theory of Groups*. Harvard University Press.
- Olson, M. (1989). Collective action. In *The invisible hand* (pp. 61-69). Palgrave Macmillan.
- Omarova, S. T. (2020). Technology v Technocracy: Fintech as a Regulatory Challenge. *Journal of Financial Regulation*, 6(1), 75-124.
- Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Ostrom, E. (2000). Collective Action and the Evolution of Social Norms. *The Journal of Economic Perspectives*, 14(3), 137-158.
- Ostrom, E. (2008). *Polycentric systems as one approach for solving collective-action problems*. Indiana University.
- Ostrom, E. (2010). Analyzing collective action. *Agricultural Economics*, 41(s1), 155-166.
- Ostrom, V., Tiebout, C. M., & Warren, R. (1961). The Organization of Government in Metropolitan Areas: A Theoretical Inquiry. *The American Political Science Review*, 55(4), 831-842.
- Parker, G., & Van Alstyne, M. (2018). Innovation, Openness, and Platform Control. *Management Science*, 64(7), 3015-3032.
- Parker, G., Van Alstyne, M., & Jiang, X. (2017). Platform Ecosystems: How Developers Invert the Firm. *MIS Quarterly*, 41(1), 255-266.
- Rose, C. (1986). The Comedy of the Commons: Custom, Commerce, and Inherently Public Property. *The University of Chicago Law Review*, 53(3), 711-781.
- Rozas, D., Tenorio-Fornés, A., Díaz-Molina, S., & Hassan, S. (2021). When Ostrom Meets Blockchain: Exploring the Potentials of Blockchain for Commons Governance. *SAGE Open*, 11(1).
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., & Jinks, C. (2018). Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*, 52(4), 1893-1907.
- Selander, L., Henfridsson, O., & Svahn, F. (2013). Capability search and redeem across digital ecosystems. *Journal of Information Technology*, 28(3), 183-197.
- Taleb, N. N. (2018). *Skin in the game: Hidden asymmetries in daily life*. Random House Trade Paperbacks.
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Digital Infrastructures: The Missing IS Research Agenda. *Information Systems Research*, 21(4), 748-759.
- Tiwana, A. (2015). Evolutionary Competition in Platform Ecosystems. *Information Systems Research*, 26(2), 266-281.
- Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research*, 21(4), 675-687.
- Urquhart, C. (2013). *Grounded Theory for Qualitative Research*. SAGE Publications.

- Vergne, J. (2020). Decentralized vs. Distributed Organization: Blockchain, Machine Learning and the Future of the Digital Platform. *Organization Theory*, 1(4), 1-26.
- von Hippel, E., & von Krogh, G. (2003). Open Source Software and the “Private-Collective” Innovation Model: Issues for Organization Science. *Organization Science*, 14(2), 209-223.
- Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014). Technology Ecosystem Governance. *Organization Science*, 25(4), 1195-1215.
- West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research Policy*, 32(7), 1259-1285.
- Zachariadis, M., Hileman, G., & Scott, S. V. (2019). Governance and control in distributed ledgers: Understanding the challenges facing blockchain technology in financial services. *Information and Organization*, 29(2), 105-117.
- Ziolkowski, R., Miscione, G., & Schwabe, G. (2020). Decision Problems in Blockchain Governance: Old Wine in New Bottles or Walking in Someone Else’s Shoes? *Journal of Management Information Systems*, 37(2), 316-348.
- Zittrain, J. L. (2008). *The Future of the Internet*. Yale University Press.