Decentralized Service: An Initiation of Blockchain Value Creation into Service Science

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Abstract

How value is created through service has recently undergone massive changes. Centralized service provision with clear distinctions between service offerers and beneficiaries is increasingly superseded by value creation within decentralized networks of distributed actors integrating digital resources equally. One of the drivers of this transformation is blockchain technology. Applying the lens of service-dominant logic and discussing examples of blockchain-based decentralized finance, we shed light on how properties of decentralized technology stimulate value creation in service ecosystems. With this conceptual research, we postulate five propositions of decentralized value creation along the axiomatic foundations of the service-dominant logic. We provide first definitions for decentralized service as well as decentralized service ecosystems. Thereby, we contribute with an extension of the service-dominant logic to the context of decentralized ecosystems. To our knowledge, this research is among the first to add to the growing literature on blockchain value creation from a service science perspective.

Keywords: decentralized service, decentralized service ecosystems, service-dominant logic, blockchain technology, collective value

1. Introduction

Integrating digital technologies has become crucial for service creation in almost every sector of society, economy, and public and private life (Yoo et al., 2012). The pervasiveness of digital computing keeps changing the landscape of value conversion in digital service (Teece, 2018). Distributed actors and resources co-create value in digitally mediated value networks, also claimed as digital service ecosystems (Böhmann et al., 2014; Fjeldstad & Snow, 2018; Jacobides et al., 2018). Digital technology supports the creation of value-in-use for intangible need satisfaction and the generativity of connections among ecosystem actors (Lusch & Nambisan, 2015). Service creation in digital ecosystems is well known for being mediated via a focal keystone that defines the allowed value paths among users (Jacobides et al., 2018). Digital value creation has thus become beneficial due to its scale, scope, and speed, while always being in full control of the ever-mediating central keystone.

Blockchain technology is altering how value is created from digital resources. Its technical properties facilitate autonomous activities among network peers without a central intermediary (Beck et al., 2018). This disintermediated value creation becomes possible from blockchain's unique properties of combining peer-to-peer technology with digital encryption and immutable data storage in chained blocks (Morkunas et al., 2019). Decentralized blockchain networks thus allow for autonomous value creation activities from a self-governing and self-regulating distributed ledger architecture *without* a mediating central agency (Andersen & Ingram Bogusz, 2019). First considerations of service provision via blockchains suggest the technology to improve reliability and coordination. Bypassing the supposed bottleneck of a central keystone admits decentralized copies of service data and more performant transactions. Blockchain implementations thus promise improved service levels from increased transparency and integrity (Seebacher & Schüritz, 2017; Zhenfeng Gao et al., 2018).

Service-dominant (S-D) logic has recently been discussed for creating value in *distributed* settings such as the Internet of Things (IoT), smart service systems, or through artificial intelligence (AI) (Beverungen et al., 2019; Manser Payne et al., 2021). In smart service systems, for example, value conversion occurs through an interplay between the involved corporation, the customers, and autonomously operating smart objects (Oberländer et al., 2018). However, research on how value arises in *decentralized* service ecosystems, particularly provided by blockchain technology, is yet in its infancy and lacks theoretical underpinning. To fill this gap, we ask: *How can the S-D perspective explain value creation in decentralized service ecosystems?*

In this paper, we introduce the concept of decentralized service to contribute to a deeper

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theoretical understanding of how blockchain technology stipulates digital value creation. To comprehend service provision in decentralized ecosystems, we ground our examination in S-D logic and illustrate blockchain value creation along the five axioms of this perspective (Vargo & Lusch, 2016). In doing so, we situate decentralized value creation in Ostrom's socio-ecological embedding along actors, interactions, resources, context, and outcomes (Ostrom, 2010).

This conceptual paper proceeds as follows (Hirschheim, 2008). First, we provide the conceptual background for our research. Building upon this and applying the lens of S-D logic, we then derive five propositions regarding the nature of decentralized service and decentralized service ecosystems. Next, we synthesize our findings to provide definitions of decentralized service as well as decentralized service ecosystems. Finally, we discuss those definitions and conclude the paper with theoretical contributions to extend the S-D logic for the context of decentralized service ecosystems. We wrap up with practical implications as well as future research opportunities.

2. Conceptual Background

2.1 Service-dominant logic and digital service ecosystems

Digital service ecosystems arrange a multitude of service creation activities through digital technology (Sklyar et al., 2019). Service systems – in general – allow to coordinate certain configurations of actors and resources for value co-creation, united by a shared idea or common sense (Böhmann et al., 2014). This common sense often guides the adoption of service architectures, for example, facilitating technology. When integrating digital technology in particular, digital service ecosystems can take advantage of the properties of digital resources in terms of scale, scope, and speed (Bharadwaj et al., 2013). As the metaphor from biology suggests, the *ecology* of digital service *eco*systems addresses the theoretically unrestrained number and the exponential growth of relations and interactions among ecosystem actors (Alaimo et al., 2020). In this line, digital service ecosystems comprise meta-theoretical foundations of S-D logic, such as (digital) resource integration, beneficial density of distributed resources, as well as building on actor-to-actor relations (Lusch & Nambisan, 2015). To organize these activities, digital service ecosystems follow institutional logics that emphasize the relations and rules which apply between the actors (Vargo & Lusch, 2016). Along the logics of ecosystem survival, digital service ecosystems also incorporate dynamics of self-adjusting and self-containing mechanisms to a certain extent (Vargo et al., 2017). These dynamics make it necessary for digital service ecosystems to constantly balance integrity and flexibility (Lusch & Nambisan, 2015). Beyond the aggregation of individual values, ecosystems can also thrive thanks to collective value creation that describes the specific benefits of highly interdependent, networked behavior (Laamanen & Skålén, 2015). These effects are supposed to stem from disciplined and benevolent cooperation as reciprocally provided by all value creating actors (Bridoux & Stoelhorst, 2022).

Digital service ecosystems represent a manifestation of digitally mediated and represented value networks (Fjeldstad & Snow, 2018). The enormous potential for interactivity coined the term of value networks, which underlines the de-specialization of value chains in favor of more complex relations between horizontally equal ecosystem actors (Michel et al., 2008). Digital technology causes this complexity by increased connectivity while at the same time facilitating coordination (Sklyar et al., 2019). The latest wave of digitization has emphasized the role of IT as operant resource, which places IT in the focus of value creation (Lusch & Nambisan, 2015; Yoo et al., 2012). Value co-creation between service offerers and beneficiaries in such digital environments is predominantly organized in digital ecosystems that pulse around one central hub. This focal keystone coordinates all activities between the non-focal actors, also called complementors (Jacobides et al., 2018). In particular, the focal keystone defines the rights, incentives, and accountability for all ecosystem activities via boundary resources, often in the shape of APIs (Ghazawneh & Henfridsson, 2013). As a compensation for their role, the keystone company often retains a fee for each realized, thus mediated activity (Jacobides et al., 2018). In this regard, co-creation of service in digital ecosystems cannot happen directly between the complementors, each ecosystem activity is indeed fully mediated and controlled by the keystone. Particular manifestations of digital service ecosystems incorporate smart devices that function as digitally hybrid boundary objects with a certain degree of autonomy (Beverungen et al., 2019). The co-creation in those smart service systems considers explicitly both human actors as well as smart devices as machinery actors (Oberländer et al., 2018).

2.2 Value creation from blockchain technology

Blockchain technology provides coordination mechanisms for autonomous verification and exchange (Allen et al., 2020; Beck et al., 2018). Being discussed as institutional technology, blockchain allows for the emergence of networks of self-governance which coordinate a widespread number of independent actors and resources (Sunyaev et al., 2021). The novelty of blockchain as a digital technology, in particular as a distributed ledger technology (DLT), stems from its unique combination of properties from peer-to-peer networks and digital encryption, as apparent in the constitution of its autonomous decentralized protocol (Glaser, 2017). The based-upon systems enable a robust computation of transactions that are hard to be manipulated or even dominated by a single actor (Morkunas et al., 2019). The provision of source code and the autonomous verification and operation of transactions can be sub-organized into three intertwined networks of development, validation, and transactions (e.g., Andersen & Ingram Bogusz, 2019). Depending on the chosen blockchain type (Beck et al., 2018), value creation activities in blockchain networks provide the opportunity to organize differently from centralized digital ecosystems, where the single keystone controls the standards for coordination among the contributors and based-upon revenue flows (Jacobides et al., 2018).

Blockchains are discussed as the foundation of the so-called Internet of Value, that is supposed to differ from the well-established "internet of information" in not just sharing and exchanging information, but transacting unique value (Lacity, 2022). Tokens as digital representation of virtual or real-world assets allow for autonomous transfer of encapsulated value (Oliveira et al., 2018). While having become popular for trading intangible assets like virtual cryptocurrencies, blockchain networks also provide the tokenization of physical assets, such as artworks, collectibles, or real estate. Such disintermediated 1-to-1 transactions require solutions to verify the identity and trustworthiness of the involved actors and traded assets. For example, this prevents double-spending in absence of third-party intermediaries such as financial payment providers, bookkeepers, or ecosystem keystones (Tapscott & Tapscott, 2016). To ensure unique transactions, it requires asset identification and evaluation as well as the definition of specific token parameters (Sazandrishvili, 2020). While tokens can also be traded via centralized mediaries, blockchain promises to transfer value faster and cheaper via decentralized coordination and verification (Lacity, 2022; Zhenfeng Gao et al., 2018).

2.3 Decentralized finance

This paper draws from illustrative examples from the empirical context of Decentralized Finance (DeFi). DeFi is an emergent movement in financial markets characterized by the decentralized provision of financial service. DeFi applications replicate and advance existing financial service and operate on top of a blockchain or DLT system through executable code (Chen & Bellavitis, 2020). Multiple market participants, intermediaries, and end-users spread over various jurisdictions and interact in a decentralized way with each other (Zetzsche et al., 2020). DeFi comes with the promise of more decentralized, innovative, interoperable, borderless, and transparent financial service offerings to its users (Chen & Bellavitis, 2020).

One of the most distinct features of DeFi is its composability (e.g., Katona, 2021). Composability is a design feature that enables various components of a system to be easily connected to form any number of satisfying results. In DeFi, the feature of composability is used to combine different technological building blocks to develop new decentralized applications (Katona, 2021).

In DeFi marketplaces, different participants like investors, arbitrageurs, users, liquidity providers, and application designers can trade and lock crypto-assets (e.g., cryptocurrencies) (Jensen et al., 2021). These assets are not necessarily traditional securities but can represent values as abstract as digital or physical art (Schueffel, 2021). One instance of a DeFi marketplace, that means a crypto exchange application built on top of a blockchain protocol, is a so-called *decentralized exchange* (DEX) (Schär, 2021). In DEXs, functionalities such as matchmaking, verification, and asset transfers are executed automatically without the involvement of third parties (Schär, 2021).

3. Propositions and Derived Definitions

To answer the research question, we discuss decentralized value creation along the five axioms of S-D logic in the following. These axioms cover the core concepts of the service perspective of value creation (Vargo & Lusch, 2016). In doing so, we derive five propositions deductively from literature and support this development by illustrative examples from the application case of DEXs as first empirical evidence. The propositions lead to the synthesis of well-informed definitions for decentralized service as well as decentralized service ecosystems (Hirschheim, 2008).

3.1 Axiom 1: Service is the fundamental basis of exchange.

The first fundamental axiom of S-D logic postulates that exchange always occurs through the creation of service (Vargo & Lusch, 2016). In distinction to goods-dominant logic, the service perspective emphasizes the intangible nature of satisfying desires and needs to be the main driver of value creation. Scale effects from the heterogeneous specialization of individual skills motivate for exchange in order to optimize personal outcomes ex-post (Lusch

& Nambisan, 2015). These outcomes can cover different values, such as economic benefits or humanistic values such as well-being. Decentralized digital architecture enables the particular coordination of exchange between a multifold of actors with heterogeneous value sets at affordable costs and high speed (Barile et al., 2017).

An example for this is a DEX. Via DEXs, crypto assets are transferred, which means the exchange of digital representations of physical or digital assets operated on a blockchain (Oliveira et al., 2018). Some of the promised advantages of such decentralized exchanges over centralized solutions as provided by traditional banks are lower latency and costs as well as more security and transparency (Chen & Bellavitis, 2020; Popescu, 2020). For example, transactions in DeFi are securely and immutably recorded and publicly visible on ledgers through distributed consensus (Chen & Bellavitis, 2020). In fact, recent improvements in the usability and liquidity of DEXs spur the hope that they are soon able to compete with centralized solutions at large scale (Popescu, 2020). Consequently, we postulate our first proposition:

Proposition 1: Decentralized service provides exchange through secure, transparent, and documented digital verification of ownership and asset transfer.

3.2 Axiom 2: Value is co-created by multiple actors, always including the beneficiary.

Another foundational assumption in the S-D logic manifests the co-creation of value by multiple actors in axiom 2 (Vargo & Lusch, 2016). Such joint interaction challenges the temporal synchronicity in service co-creation, especially regarding human actors (Lusch et al., 2007). Overcoming the outdated thinking of uni-directional service delivery and subsequent passive consumption, this axiom continues the condition for the service beneficiary to also integrate resources in service creation, in addition to the service offerer. Digital resources provide the opportunity of being deferred until the time of use without noteworthy losses in quality (Yoo et al., 2012). In this line, the integration of digital resources provides beneficial opportunities for distributed service creation as spanned over time and space.

In decentralized blockchain systems, value is co-created by the interactions of distributed actors who can be humans or machines. A particularity in this is the potentially high degree of automation in service creation, when autonomously operating applications get into action from the agency granted. Value arises hereby first when the actual transaction (i.e., a crypto-asset transfer) takes place. In DeFi, this allows for novel financial products and services. Two such examples related to DEXs are flash loans and automated market makers. Flash loans enable users to automatically lend a potentially huge amount of crypto-assets without the need for a collateral provided that the borrowed assets can be repaid within the same transaction (Wang et al., 2021). Automated market makers use a peer-to-peer procedure and determine prices of assets algorithmically via a conservation function instead of matching the supply and demand side as is the case in centralized exchanges (Xu & Vadgama, 2022). The beneficiary is always involved in the creation of this type of autonomous decentralized service. For example, human or algorithmic crypto investors need to connect their digital wallets to the application via which they would like to trade. Hence, we present the second proposition:

Proposition 2: In decentralized service, value cannot only be co-created by different human actors but also through human-to-machine and machine-to-machine interactions.

3.3 Axiom 3: All social and economic actors are resource integrators.

The vision of ubiquitous computing postulates welfare from the properties of digital technology through increased service quality and supplemental convenience at low cost (Yoo et al., 2012). The consideration of digital resources as operant resources in service creation brings all social and economic actors in the potential role of resource integrators, in line with axiom 3 (Vargo & Lusch, 2016). In decentralized networks, the absence of a central keystone makes their dominant position in defining and providing boundary resources and the encoded rules and norms of exchange obsolete (Ghazawneh & Henfridsson, 2013). Access to boundary conditions becomes substituted by the autonomous blockchain protocol and supporting validator nodes, which secure the normalized execution of each transaction (Morkunas et al., 2019). Consequently, when nodes are increasingly interchangeable in decentralized networks, the roles of the actors become rather similar (generic) and the attributes of the integrable resources equalized (normalized) (Bridoux & Stoelhorst, 2022).

This is apparent in many DeFi applications where crypto-assets can be transferred in a peer-to-peer form without the need for intermediaries (Xu & Vadgama, 2022). These applications are usually highly composable so that customized and very flexible financial products and services can be developed instead of the often-standardized solutions offered by centralized financial intermediaries. For example, different building blocks such as DEXs, liquidity pools, and automated market makers can be assembled and thus enable a form of composable liquidity (Harvey et al., 2021). The creation of these composable solutions requires the integration of homogeneous resources of varying actors. For instance, blockchain developers assemble this decentralized financial service. Users, such as crypto investors, on the other hand connect their wallets to the applications they want to transact on (e.g., a DEX). In a third network, validators verify the transactions so that they can be executed and appended to the blockchain on which they are computed. Following the interchangeability of nodes as generic network actors, we suggest:

Proposition 3: Decentralized service is created by generic actors who integrate digital resources of normalized attributes.

3.4 Axiom 4: Value is always uniquely and phenomenologically determined by the beneficiary.

Axiom 4 discusses that "value is always uniquely and phenomenologically determined by the beneficiary" (Vargo & Lusch, 2016, p. 8). Within a service network, all actors are providers and beneficiaries in reciprocal service exchange (Barile et al., 2017). The complex interconnectivity between generic actors motivates a collective perspective, where the multifold and multisided co-creating activities constitute collective behaviors from their interdependence (Laamanen & Skålén, 2015). The autonomous blockchain protocol enables the conditions for collective value creation by providing collaboration via simultaneous benevolence, discipline, and individual incentives (Bridoux & Stoelhorst, 2022). Vargo and Lusch emphasize the "nested and overlapping" character of service ecosystems for achieving "shared purposes" (Vargo & Lusch, 2016, p.16), which conceptually reflects the logics of collective value. The postulated individual value determination of the beneficiary in S-D logic becomes complemented by collective value as an outcome of coordinated behavior in highly intertwined, cooperative networks.

Blockchain-based applications such as DEXs induce certain subeconomies (Beck et al., 2018), in which human and machine actors are incentivized to collectively maximize the overall system value. At the same time, the compensation of each user might also increase. This collectively generated value can appear in different forms. For instance, it can be the value of the crypto-assets traded on the DEX. Also, it could realize in value anchored in and emanated from the mechanisms inherent to a blockchain system. In DEXs, service exchange (i.e., crypto-asset transfers) is recorded as well as immutably and transparently stored on a distributed ledger (Monrat et al., 2019). This allows for secure transactions with unknown parties as confidence is created by those properties (Filippi et al., 2020). Moreover, it enables to verify owners and the history of ownership. This can bring huge advantages in time and security when it comes to auditing (Schmitz & Leoni, 2019). Thus, our fourth proposition reads:

Proposition 4: Cooperation for decentralized service generates additional value creation opportunities that extend the perspective on beneficiaries to the network collective.

3.5 Axiom 5: Value cocreation is coordinated through actor-generated institutions and institutional arrangements.

According to Vargo and Lusch (2016), the addition of institutional logics into the S-D perspective provides the fundamental understanding on resource integration and exchange activities in interdependent and complex service ecosystems. Institutions help to place the value-creating activities in a contextual environment of flanking rules, norms, meanings, or practices – initially humanely devised. These rules aid cooperation to a level of more interdependent collaboration. In decentralized service ecosystems, the S-D actor-to-actor perspective is continued to describe resource integration beyond monetized exchange, but also embeds the value creation activities into a context of interrelation and interdependence. At a system level, institutional arrangements explain value creation among independent assemblages of institutions (Vargo et al., 2017), such as specific value creating subeconomies in blockchain networks (Andersen & Ingram Bogusz, 2019). The rule bundles can be applied at different layers of networks, thereby providing decentralized blockchain solutions in a layered architecture (Vargo & Lusch, 2016). In general, blockchain architecture also allows for changing the digitally encoded rules, e.g., through joint decisions of developers (Beck et al., 2018).

Blockchain systems and their protocols are considered to be institutional technologies, enabling different applications such as DEXs to be operated on (Davidson et al., 2018). A DEX protocol hereby embodies a bundle of rules that determines the governance mechanisms of a DEX (Schär, 2021). It provides standards on how crypto-assets can be transferred on a marketplace. Moreover, it can also enable other DeFi protocols to use this marketplace and hence allows for a sense of inter-operability between different DeFi ecosystems (Schär, 2021). As noted by Lusch & Nambisan (2015), service ecosystems need to have both structural integrity and flexibility. With respect to DEX-based ecosystems, the actually hard-wired protocols can be adjusted through a procedure called forking. Forking means either backwards-compatible (soft forking) or backwards-incompatible (hard forking) code changes in the protocol in a selforganized manner (Andersen & Ingram Bogusz, 2019). An example in DeFi is a hard fork after a hacker attack on the first decentralized autonomous organization called "The DAO" set up as an autonomously operating investor-directed venture capital fund (DuPont, 2017). Therefore, our fifth proposition reads:

Proposition 5: The generation of decentralized service is embedded in an inherently hard-wired and yet alterable context of institutional logics.

A summary of our findings is provided in Table 1.

Table 1. S-D logic axioms, derived propositions, and DEX examples

S-D Logic Axiom	Proposition	DEX Example
1: Exchange by service	Decentralized service provides exchange through secure, transparent, and documented digital verification of ownership and asset transfer.	Exchange of crypto-assets
2: Multiple co-creating actors	In decentralized service, value cannot only be co-created by different human actors but also through human-to-machine and machine-to-machine interactions.	Flash loans, automated market makers
3: Social and economic resource integrators	Decentralized service is created by generic actors who integrate digital resources of normalized attributes.	Liquidity pools, automated market makers
4: Value determination	Cooperation for decentralized service generates additional value creation opportunities that extend the perspective on beneficiaries to the network collective.	System-induced confidence and verification
5: Institutional embeddedness	The generation of decentralized service is embedded in an inherently hard-wired and yet alterable context of institutional logics.	DEX protocols, forking

Drawing from our theoretically derived five propositions (Hirschheim, 2008), we synthesize their core arguments as additives and conditions for defining decentralized service. We particularly consider the environmental context of enacted institutional logics and thereby present a second definition specifying decentralized service ecosystems.

Definitions of Decentralized Service and Decentralized Service Ecosystems:

Decentralized service denotes exchange among distributed human and machine actors who integrate normalized digital resources in an autonomous, secure, transparent, and documented way to create value jointly in a hard-wired but still alterable institutional context.

Decentralized service ecosystems comprise institutional logics which allow the interdependent and simultaneous creation of collective value from a multifold of decentralized service provisions.

4. Discussion

In this paper, we position decentralized value creation in the context of digital service ecosystems. We evaluate the five axioms of S-D logic in the light of blockchain systems and thereby postulate five propositions how service creation unfolds in decentralized ecosystems. As follows, we discuss our definitions of decentralized service and decentralized service ecosystems along the elements of Ostrom's socio-ecological system, comprised of actors, their interactions, resources, value-determining contexts, and outcomes (Ostrom, 2010). By this, we also suggest the applicability of the derived definitions to other fields than the illustrative example of DeFi, e.g., smart service.

Exchange in decentralized service ecosystems builds upon distributed technologies such as peer-to-peer. Distributed technologies use resources of multiple forms and locality to create value via the autonomous interplay and coordinated interrelationships of multiple actors (Barile et al., 2017). Through these complex interactions, horizontal organizing of direct, disintermediated value creating activities becomes dominant among peers. Following proposition 1, the digital ownership of assets, that represent digital or physical properties, can be securely and transparently verified and transferred in decentralized ecosystems through tokens (Oliveira et al., 2018). These attributes facilitate value-in-use in decentralized service ecosystems, drawing from coordination mechanisms as inherent in blockchain technology.

Given the distributed architecture, value creating activities can be located in many places in decentralized service ecosystems. Mediation via a focal keystone, as present in centrally managed digital ecosystems (Ghazawneh & Henfridsson, 2013), can become obsolete, since all value creating activities can be organized in a decentralized way, for instance, enabled by a blockchain protocol that covers all encoded system mechanisms. Actors in decentralized service ecosystems follow generic roles, meaning that the resources they integrate comprise normalized attributes (proposition 3). The imbalance of unilaterally defined boundary resources in central value creation evens out when decentralized consensus mechanisms replace their functionality of verification and identification. Actors who co-create decentralized service can be of human nature or machinery kind, which supports an autonomous execution of transactions and value creation at scale (proposition 2). Smart devices distributed in service ecosystems, for example, often operate as autonomous machinery actors along normalized resource attributes (Oberländer et al., 2018). To fully take advantage of decentralized service in line with our definition, the contextual and transactional data of smart devices need to be also stored and secured in a decentralized, redundant manner (Beverungen et al., 2019; Zhenfeng Gao et al., 2018).

The institutional logics provide the context of how actors, activities, and resources can interrelate in creating value in a decentralized service ecosystem. For the case of blockchain, these logics are hard-wired in the protocol that defines the range of allowed activities and how they are coordinated, how they become autonomously executed, and how they are encapsulated into blocks and appended to the chain. These digitally encrypted rules and norms fulfill the precondition of service ecosystems to define the institutional environment how service creation interdepends (proposition 5). The hard-wired rules ensure integrity in the decentralized service ecosystem, while at the same time allowing for flexibility and system adaptation to some extent (e.g., through code forking in the case of blockchains). A structurally enabled trade-off between integrity and flexibility is required for the ecosystem to thrive and to ensure suitable levels of mutual value creation (Lusch & Nambisan, 2015). In lack of a central authority, the execution of the protocol needs to be realized by the ecosystem actors themselves. As suggested by the S-D logic, institutional arrangements also help to explain the interrelations between more segregated assemblages of actors and resources in a decentralized ecosystem, such as distinct networks of developers, validators, and transactors as in the case of blockchain (Andersen & Ingram Bogusz, 2019). Succeeding centralized platforms, the coordination of scattered resources, actors, and activities in the decentralized service ecosystem are given in the collective hands of shared institutional logics and are carried out by the predefined design principles (Bridoux & Stoelhorst, 2022).

The outcomes of the socio-ecological activities in decentralized service ecosystems create value of multiple types. The participation of multiple actors motivates the need to manage manifold, heterogeneous values, which becomes technically ensured by stable and secure coordination and consensus mechanisms (Barile et al., 2017). Individual value for actors might predominantly arise from the attributes of decentralized activities (proposition 4). These activities are distinguishable by suppressing undesirable manipulation via retrieving the trustless, immutable, and auditable blockchain entries. Value for actors in decentralized service ecosystems can also arise from broad access to a variety of service, products, and crypto-assets of previously limited availability, or hitherto limited due to high expense of time and cost (Morkunas et al., 2019). However, decentralized ecosystems do not only provide already existing service efficiently or faster, but also service creation opportunities of novel kind, like composable liquidity in DeFi (Harvey et al., 2021). In the context of smart service systems, novel offerings comprise for example smart meters and grid infrastructures, smart cars, and autonomous manufacturing (Beverungen et al., 2019).

Following our arguments, the discussion supports the derived definitions of decentralized service and based-on institutionalized ecosystems. The multiple and interdependent interrelations of ecosystem actors following heterogenous preferences suggest a collective perspective on decentralized service. The multisided and autonomous service co-creation in decentralized ecosystems implies collective behaviors that go beyond the mediated activities of focal keystones (Laamanen & Skålén, 2015). Collective value creation underlines how the interconnection of the manifold activities affects the outcome of the entire ecosystem, following the logics of commons (Bridoux & Stoelhorst, 2022; Ostrom, 2010). Through creating collective value, decentralized service ecosystems substantiate the theoretically suggested "shared purposes" (Vargo & Lusch, 2016, p.16) exemplarily.

5. Conclusion and Future Research

This conceptual paper provides an evaluation of blockchain value creation from the S-D perspective. We derive definitions for decentralized service and decentralized service ecosystems. By doing so, we hope to inspire the rising field of value creation research in blockchain science and to amplify the well-developed stream of blockchain governance investigations. Through elaborating blockchain value creation along its five marking axioms, we extend the S-D perspective to the context of decentralized digital service ecosystems. Embedded in the institutional logics of S-D thinking, we highlight the emerging relevance of collective value creation when economies and societies become increasingly intertwined through networked autonomy. Under such conditions, outcomes of activities might affect resource configurations of other actors immediately and at scale, as inherent from the underlying digitally distributed ledger infrastructure.

Grounded in S-D thinking (Lusch & Nambisan, 2015; Vargo & Lusch, 2016), we find that digital service tends to grow more secure, transparent, and scalable when generated in decentralized autonomous ecosystems. Resource integrators become more generic along the logics of the underlying peer-to-peer networks, while at the same time heterogenous values can be served and created through the offered functionalities of identification and validation from the decentralized technology. The recently added institutional elements in S-D logic (axiom 5, Vargo & Lusch, 2016) provide theoretical grounding to redefine interdependent and likewise disintermediated value creation in decentralized digital service ecosystems. Building on these institutional logics allows a major contribution to service science by reasoning how decentralized service ecosystems thrive.

Decentralized service ecosystems prompt consideration of the logic of commons to grasp value creation from interdependent and autonomous activities. Synchronous need-orientations interfere with each other and cause effects of self-adjustment. Blockchain's unique combination of technological properties from peer-to-peer and encryption provide the infrastructural backbone for autonomous verification of ownership, activities, and managing identities. We recognize how such mechanisms of polycentric institutional governance become inherently transcribed in the boundary conditions of service ecosystems, e.g., as hard-wired in blockchain protocols (Davidson et al., 2018; Ostrom, 2010; Vargo & Lusch, 2016). For future research, we would like to consider these institutional logics to inspire further theorizing on decentralization, e.g., to differentiate between blockchain types (Beck et al., 2018). In this line, the evaluated S-D perspective on blockchain value creation might also provide the theoretical background to explore decentralized autonomous organizations and decentralization in smart service ecosystems (Beverungen et al., 2019; Filippi et al., 2020; Swan, 2015).

As a contribution to digital value creation, decentralized service becomes distinguishable through the immutability of the blockchain protocol, that ensures the consistency of ownership over space and time. The decentralized handling of transactions and transparent documentation of ownership and value transfer subsidize central intermediaries, like central keystones in extant digital ecosystems. Such disintermediated value creation provides opportunities for novel service offerings and an increase in service levels and service quality without service co-creators being consciously aware to attribute these positive effects to the decentralized architecture (Morkunas et al., 2019; Seebacher & Schüritz, 2017). Theoretically, decentralized transactions should benefit from decreasing costs and an acceleration of speed – real-world implementations, for instance, in the sector of crypto-currency, paradoxically provide rather contradictive evidence (Lacity, 2022; Zhenfeng Gao et al., 2018). When overcoming those current limitations, decentralized service ecosystems might follow the same exponential growth that allowed centralized digital platforms to become the most valuable companies in the world and augment or even subsidize centrally mediated value creation (Alaimo et al., 2020).

Our findings have several implications relevant to practitioners. They might help business decision makers and blockchain service providers to better understand decentralized business models and in particular the offering of services via decentralized platforms like DEXs. It is especially important to comprehend that value creation in decentralized service ecosystems happens through collective actions which need to be incentivized within the encoded governance system. Our findings are also relevant for other actors in decentralized systems such as developers, validators, and users. These actors need to be aware of that their actions are highly intertwined, and their interplay defines how the overall value of the system becomes distributed among them. Developers create and maintain the system. Validators ensure the ecosystem's boundary conditions and thus induce security, trust, and auditability. Lastly, users contribute to the realization of the collectively created value by distributing assets which manifests decentralized service. Apart from this, investors might benefit from our insights when it comes to analyzing and comparing different decentralized ecosystems as investment opportunities.

Regarding future research, we invite other researchers to use our paper as starting point for further projects on decentralized service, decentralized service ecosystems, and based-on collective value creation. We consider a validation of our propositions through more examples outside of the blockchain and DeFi space. An empirical cross-validation of our findings and definitions can be beneficial to substantiate our deductive theorizing. For example, future research may examine specifics of decentralization in providing smart service. Further research on decentralized service might also adopt a complex-adaptive systems point of view to substantiate our theoretical framing.

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