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Where blockchain could help - An analysis of challenges in ecosystems blockchain technology may help to solve

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Where blockchain can help – An analysis of challenges in ecosystems blockchain technology may help to solve

Emergent Research Forum (ERF) Paper

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Abstract

Ecosystems are constructs of joint value creation of different organizations that differ from classical value creation settings by their structure and might bring specific challenges. Blockchain technology offers particular traits that might bring the potential to help overcome some of the challenges. Using a systematic literature review, we identify 24 specific challenges in ecosystems and provide mapping on where blockchain technology can help to solve them.

Keywords

Ecosystems, challenges, distributed ledger technology, blockchain technology

Introduction

Today, companies increasingly find themselves in settings of joint value creation that are sometimes described as ecosystems (Moore, 1993). This development is even amplified by the rise of digital technologies, which enable new organizational processes and shift organizational boundaries (Cennamo et al., 2020). Ecosystems offer the possibility of disproportionally gaining for their actors (Adner, 2017). Such settings might bring challenges for organizations based on the specificity of such settings regarding the lack of formal coordination (Adner, 2017), needing attention to be successful.

The utilization of technology has received attention to facilitate and support settings requiring coordination among a set of actors with diverging interests, such as reducing coordination costs and establishing a trustworthy and secure environment (Kretschmer et al., 2022). Hence, an application of the technology considering ecosystems seems reasonable. As one concept of distributed ledger technology (DLT), blockchain offers the chance to enhance existing, strengthen, or drive new value creation in ecosystems (Malhotra et al., 2022). However, implementing blockchain technology comes with technical and non-technical requirements and is not a 'one-size-fits-all' solution. Given its unique characteristics, it is necessary to investigate what ecosystem challenges it may help solve.

Identifying challenges and how blockchain technology might enable solving them is of high relevance for organizations that what to engage in ecosystems for joint value creation. By knowing a) the challenges and b) which are solvable by blockchain technology, they could adjust their strategies accordingly.

Ecosystems form new structures for value co-creation (Adner, 2017; Jacobides et al., 2018) and differ from other value co-creation settings, exemplarily by the absence of full hierarchical control (Jacobides et al., 2018). Hence, it could be assumed that challenges occur in engaging in ecosystems that must be solved for success. As of today, scholarly evaluations of specific challenges are still absent. First evaluations from practitioners suggest that the wrong configuration of the ecosystem setting and the wrong choice for governance are reasons that are especially relevant for failure (Pidun et al., 2022). This is especially critical since the potential for creating value in ecosystems is deemed to go beyond traditional value-creating settings (Adner, 2017).

We aim to identify ecosystem challenges and provide insights into which of these are possibly supported to be solved by blockchain technology. Contemporary literature considering interfirm collaborations (such as ecosystems) or blockchain is available on a large scale and is continually integrated thematically (Guggenberger et al., 2020; Lustenberger et al., 2021; Papanikolaou et al., 2023; Schmeiss et al., 2019). However, considering blockchain, the technical perspective is still largely present, and managerial implications are rare. Further, missing or failed initiatives foster ambiguity regarding the adequate utilization of blockchain technology and the problems that it will solve.

Thus, our research is guided by the question: What are ecosystem challenges that blockchain technology can help *solve?*

For practitioners, gaining knowledge on the challenges to be solved in ecosystems offers essential insights for engagement decisions in such value co-creation settings. Further, knowing which of these challenges the application of blockchain technology provides a solution avenue might enable to develop fitting solutions for the challenges that might emerge. We aim to add to scholarly research in blockchain research by providing further insights into the potential of this new technology to solve specific problems. Further, we aim to add to the ecosystem research sphere by providing insights into challenges that might emerge in such endeavors.

We argue that, based on our literature review, 24 challenges for ecosystems are identifiable and can be clustered into four classes. We further show that 10 of these challenges might offer high potential to be supported by blockchain technology.

The paper proceeds as follows: first, background information on ecosystems and blockchain technology will be provided. Second, we describe the method chosen to answer the research question. Third, preliminary results are presented. Last, we summarize and propose an outlook for the future research process.

Background

Ecosystems describe the alignment structure of independent actors that aim to achieve a joint value proposition (Adner, 2017; Moore, 1993). Such settings differ from other settings of value co-creating actors, among other things, by the absence of full hierarchical control (Adner, 2017; Jacobides et al., 2018) and the existence of specific multilateral complementarities (Jacobides et al., 2018). Such differences to other rather traditional constellations of doing business might then exemplarily increase the coordination effort necessary to align the actors towards a shared goal or demand different mechanisms to control the actors different from already established mechanisms in already known value-creation settings.

Blockchain technology has experienced an upsurge of excitement to eradicate intermediary functions through a peer-to-peer (P2P) transaction system called Bitcoin (Feulner et al., 2022; Nakamoto, 2008). As a distributed ledger technology (DLT) concept, blockchain inhibits a distributed P2P network and a particular public key cryptography and consensus mechanism (El Ioini & Pahl, 2018; Hawlitschek et al., 2018). The *P2P network* is set in the form of a distributed ledger with independent and interconnected nodes with access rules and rights. Single points of failure are obsolete since immutable copies of the ledger are replicated and distributed among nodes. *Public key cryptography* comprises a digital identity for every actor (public and private key) within the network and establishes a secure and traceable environment (El Ioini & Pahl, 2018). The *consensus mechanism* is a protocol that aims at a collective agreement between all network participants on the state of the distributed ledger and its records (Maull et al., 2017) and makes intermediary functions obsolete (Burkhardt et al., 2018). Recent applications of

blockchain are manifold, and business models and use cases are increasingly emerging, ranging from the most traditional trading of cryptocurrencies (e.g., Bitcoin or Ethereum as underlying values of subsequent blockchains), tracking and tracing of goods (e.g., food or medicals), to the establishment of ownership of digitalized assets such as art or gaming content (e.g., the non-fungible token market). Within ecosystems, blockchain technology may help to enhance existing, strengthen, or drive new value creation (Malhotra et al., 2022). Further, it may help to coordinate ecosystems through standardized and automated interactions between actors and to capture created value (Schmeiss et al., 2019).

Methodology

Building on vom Brocke et al. (2009), we performed a structured and systematic literature review to find high-quality writing at the intersection of ecosystems and challenges. The initial research framework relies on Cooper's taxonomy (1988) and focuses on ecosystem challenges. We selected six databases for our structured and systematic literature review: ACM Digital Library, AIS eLibrary, Ebsco Host, IEEE, Science Direct, and ProQuest. We were able to formulate an appropriate search query by selecting pertinent terms around ecosystem challenges: *((Business Ecosystem OR Platform Ecosystem OR Innovation Ecosystems) AND (Challenge* OR Issue* OR Problem*))*. While "issue" and "problem" are frequently used as synonyms for challenges, the several ecosystem categories (business, platform, and innovation) are well-established literature (Jacobides et al., 2018). We focused on English literature only for further detailed analysis following a publication filtering mechanism (title, abstract, date keyword filter). The final sample selection followed the screening for titles, abstracts, and full texts and was expanded by a backward search, as Webster & Watson (2002) recommended. We removed duplicates from each database (*) and between databases (**). The search process is summarized in figure 1, resulting in 38 relevant articles. In the subsequent analysis, we used a coding scheme to extract the ecosystem-related challenges from the identified articles. After extraction, we assessed the challenges according to their relevancy (times mentioned) and arranged them applying the classes of the business engineering framework (Baumöl, 2008). Finally, we analyzed and evaluated which specific ecosystem challenge blockchain, based on its characteristics (P2P network, public key cryptography, and consensus mechanism), may help to solve. In this context, we established the scaling (no support, low, medium, and high support).

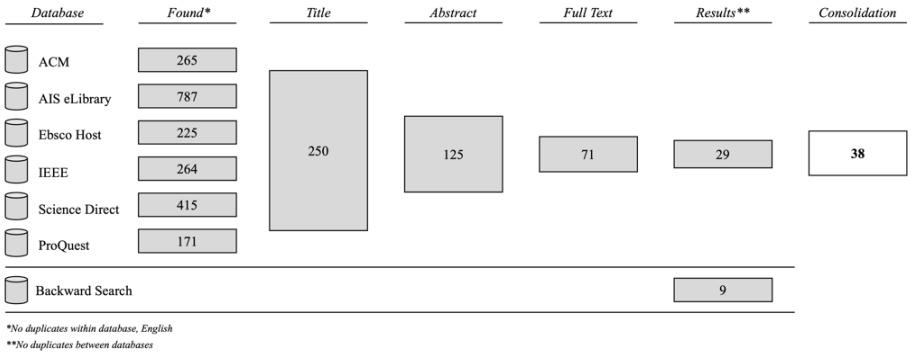


Figure 1: Structured and systematic Literature Review Process

Preliminary Results

Reviewing the literature, we 24 challenges were identified we then classified them into four classes according to the business engineering framework (Baumöl, 2008). The business engineering framework was chosen since it covers the four dimensions that organizations need to consider regarding change projects: strategy, organization, architecture, and culture (Baumöl, 2008). Out of the 24 challenges, most are to be allocated within the dimension of *Strategy,* while only four are to be allocated in the dimension of C*ulture*. In addition to the allocation in dimensions shown in figure 2, we ranked the relevance according to counting how often the respective challenge was mentioned in the literature. Our first results already show differences between the challenges identified. Exemplarily, *Ecosystem strategy and business model scope* seem to be the most relevant challenge according to the mentions in the literature

(19 mentions), while *Ecosystem legacy system integration* only is of minor relevance (four mentions). For each challenge, we rated its support by blockchain (no support, low, medium, and high) based its specific traits drawing on our expertise in blockchain.

		Challenge	Relevance (n)		Blockchain support
Strategy	S1	Ecosystem strategy and business model scope	●●●●●●	19	No
	S2	Ecosystem joint vision of actors	●●●●	12	Low
	S3	Ecosystem coordination and management	●●●●	10	High
	S4	Ecosystem governance mechanisms and policies	●●●●●●●	18	High
	S5	Ecosystem relevant actor/process/system identification	●●●	8	Low
	S6	Ecosystem trust among actors	●●●	8	High
	S7	Ecosystem economic value distribution	●●	6	Medium
	S8	Ecosystem intellectual property protection	●	3	High
Organization	O1	Ecosystem organizational process redesign	●●	4	High
	O2	Ecosystem organizational process standardization	●●●	7	High
	O3	Ecosystem fair definition of key roles (e.g. orchestrator)	●●●●	10	No
	O4	Ecosystem workforce competencies	●●●●	10	No
	O5	Ecosystem knowledge sharing and learning	●●●●	9	No
	O6	Ecosystem external regulations and compliance	●●	4	Medium

		Challenge	Relevance (n)		Blockchain support
Architecture	A1	Ecosystem data and system interoperability	●●●●	10	Medium
	A2	Ecosystem data and system standards	●●●	9	High
	A3	Ecosystem distributed and scalable computing systems	●	3	High
	A4	Ecosystem legacy system integration	●	1	Medium
	A5	Ecosystem data and system security	●	3	High
	A6	Ecosystem data and system privacy	●	3	High
Culture	C1	Ecosystem actor leadership	●●	6	No
	C2	Ecosystem culture towards decisions/communication	●●●●	10	No
	C3	Ecosystem collaborative mindset	●●●	9	No
	C4	Ecosystem top management attention and skills	●	3	No

Scale	
1-3	●
4-6	●●
7-9	●●●
10-12	●●●●
13-15	●●●●●
16+	●●●●●●

Figure 2: Preliminary Ecosystem Challenges and their Relevance

We found that blockchain technology can provide high support for the *Strategy* dimension concerning the challenges (S3) Ecosystem coordination and management, (S4) Ecosystem governance mechanisms and policies, and (S6) Ecosystem trust among actors. Blockchain can support coordination, management, and governance mechanisms in ecosystems since the P2P network with nodes in the form of individuals or individual organizations is governed automatically by smart contracts comprising code-based instructions executed upon the occurrence of a particular event. The consensus mechanism and the public key cryptography benefit coordination, management, governance, and trust-building efforts by a joint agreement upon chosen consensus mechanism, traceability of actions, and the clarification of digital ownership, providing a secure and trustworthy environment. We found medium support of blockchain for (S7) the distribution of economic value, as the technology could help to establish mechanisms to track transactions via public-key cryptography, thus providing opportunities to distribute economic value accordingly.

Within the *Organizational* dimension, we found that blockchain technology offers high support for the ecosystem (O1) in redesigning processes and (O2) in standardizing processes. The deployment of blockchain itself implies initiatives toward redesigning and standardizing an integrated infrastructure. Ultimately, process redesign and standardization benefit the ecosystem by delivering options for linking further actors and their processes, ultimately providing positive scalability effects. In addition, we found medium support for (O6) External regulations and compliance in the ecosystem, as this strongly depends on the imposed regulatory or compliance types. However, blockchain offers options such as traceability using public-key cryptography and clarifies digital ownership, enabling visibility into executed transactions.

Within the *Architecture* dimension, we found high support of blockchain for challenges (A2) Ecosystem data and system standards and (A3) Ecosystem distributed and scalable computing systems by establishing a mainstreamed P2P infrastructure and scalability options through expanding nodes (i.e., individuals or organizations). Further, blockchain technology supports (A5) Ecosystem data and system security and (A6) Ecosystem data and system privacy through the P2P network entailing the replicated and shared ledger of transactions and public key cryptography, establishing a secure and traceable environment. We found medium support for (A1) data and system interoperability and (A4) legacy system integration. The interoperability challenge (between blockchains) is still an issue that needs to be resolved. However, blockchain may act as a means to facilitate operations between several (legacy) systems if standardized processes and data sources are placed.

In our view, blockchain may encourage collaboration, however, fails to address cultural challenges (C1 – C4) that are impacted by human behavior.

Conclusion

The preliminary results provide insights into the challenges in ecosystems and the first attempts on which of these are supported to be solved by blockchain technology. We identified 24 challenges in ecosystems and could already distill 10 of these challenges whose solution might be beneficially supported by applying blockchain technology. Hence, we offer essential insights for practitioners that aim to engage in

ecosystems and add to research by combining ecosystem- and blockchain research. In the future, we aim to validate our findings in investigating existing ecosystems to gain additional insights into the challenges to be solved. Therefore, a case-study approach might offer us essential insights into ecosystem challenges. In addition to adding more grounding to the challenges identified, it might offer us insights into possible differentiations between the challenges perceived by actors in business ecosystems regarding their role. What is more, adding to the problem of validating the results, we plan to quantitively assess the mapping of the challenges in different classes by approaching a broader set of experts from different organizations that are engaged in ecosystems as well as qualitatively approaching blockchain experts for further insights into the blockchain technology mapping with the challenges identified. The results will be published in future publications as we proceed with research.

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