Tokenizing coopetition in a blockchain for a transition to circular economy

TOKENIZING COOPETITION IN A BLOCKCHAIN FOR A TRANSITION TO CIRCULAR ECONOMY

ABSTRACT:

The circular economy offers a way for businesses to conceptualize sustainable economic activity with a concern for environmental and societal wellbeing. Putting this concept into practice is a complex undertaking, given the current production and consumption systems, and necessitates strategies that enable competition and cooperation between various actors to generate and scale up the best ideas. Simultaneous competition and cooperation, or coopetition, is studied in strategy literature within the context of managing the complexity of business networks. Coopetition could offer valuable perspectives for firms transitioning to circular models. The purpose of this paper is to show how coopetition could be operationalized and optimized using tokens in a blockchain to support a transition to circular models of value creation and appropriation. The findings of our study indicate that tokens could enable previously disconnected product ecosystems to converge and unleash the waves of creativity and innovation required for circular business models. However, facilitating such convergence would require the coopetition models to transition from comprising the current stages of value creation and appropriation to being based on value creation and circulation.

Keywords: Sustainable; Circular Economy; Coopetition; Blockchain; Token Economy

Highlights

- Circular economy networks require strategies that enable cooperation and competition between actors to generate and scale up ideas
- Building circular economy ecosystems is complex and product biographies is a viable way of conceptualizing such ecosystems

- Tokens on blockchains could offer incentives to cooperate and compete for creating circular economy ecosystems

1. Introduction

A growing global population, coupled with increasing economic activity, is accelerating resource use, societal imbalances, and environmental destruction (Bocken et al., 2014; Bocken and Antikainen, 2018). Competition for resources has resulted in calls to improve the productivity around the use of resources and consequently, focusing on productivity and the use of resources has become critical when managing sustainability issues (Boons et al., 2013; Mudgal et al., 2012; Dobbs et al., 2011). For businesses, it is important to consider that limitless exploitation of resources to stimulate economic activities is no longer feasible and linear supply-chain models demand rethinking (Bocken and Antikainen, 2018; Schulte, 2013; Rifkin, 2009).

The circular economy (CE) has emerged as an alternative approach intended to keep products, components, and materials in circulation while retaining their value (Bocken et al., 2017). Firms and organizations are currently exploring the CE as a model for conceptualizing the integration of sustainability into economic activities (Murray et al., 2017; Bocken et al., 2015). Research on the CE has focused on the origins of the concept (Frosch, 1992; Ehrenfeld and Gertler, 1997; Erkman, 1997; Preston, 2012), single case studies (Prendeville et al., 2014; Schnitzer and Ulgiati, 2007; Ramani et al., 2010), and implementation on the meso level (industrial parks; Chertow, 2000, 2007; Chertow and Ehrenfeld, 2012; Conticelli and Tondelli, 2014) and on the macro level (cities, provinces, and nations; Su et al., 2013; Naustdalslid, 2014).

Lieder and Rashid (2016) note CE literature contains scant research on the management strategies that could help firms operationalize CE models. As firms explore the means of value creation at both the firm and the societal level in light of the promise of the CE, they need viable strategies to facilitate the transition. Firms able to move beyond optimizing individual performance through restructuring and to rethink existing systems and processes and that can then co-create sustainable marketplaces will gain a competitive advantage (Loorbach and Wijsman, 2013). This point relates to both collaborative and competitive, or coopetitive, activities. Bengtsson and Kock (2014: 182) define coopetition as “a paradoxical relationship between two or more actors simultaneously

involved in cooperative and competitive interactions, regardless of whether their relationship is horizontal or vertical." Coopetition has been studied in the fields of strategic management and industrial marketing (e.g., Bengtsson and Kock, 2000; Dagnino and Padula, 2002; Dorn et al., 2016; Fernandez et al., 2019; Gnyawali and Park, 2011). One stream of coopetition research (Tidström and Rajala, 2016; Bengtsson and Kock, 2014; Ritala and Tidström, 2014; Bengtsson et al., 2010; Brandenburger and Nalebuff, 1995, 2011) focuses on value creation and appropriation.

For CE models, both the competition and the cooperation between actors are important and combining the underlying principles of the CE with a strategy of simultaneous cooperation and competition is worth exploring. Building CE ecosystems is complex, and Spring and Araujo's (2017) concept of product biographies is a starting point for developing our idea. Spring and Araujo (2017) use product biographies to highlight the inherent instability of products, both physically and institutionally, and the managerial and institutional effort required to stabilize and process products for exchange or service value creation. They argue that within the CE context, there is an emphasis on products qualified by and constitutive of a distributed network. The perspective that visualizes a product as a distributed network instead of a single entity opens up spaces for innovative entrepreneurial opportunities at every transition point within the products' lifecycle. As multiple product biographies unfold, revealing potential value creation opportunities, the existing networks will require reconfiguring.

This reconfiguring could be understood as the decentralization of the product; instead of one central authoritative understanding, the product can then be understood within the various contexts by revealing information about its production and consumption lifecycle. These information contexts offer opportunities to develop a competitive advantage while employing cooperation for creating the value of the product. In redirecting the focus away from the product and toward its biography, the network of actors expands to include those that have not traditionally been directly part of firms' networks. Individuals and actors indirectly linked to the product's ecosystem become equally relevant sources, validators, custodians, and traders of information and knowledge related to the ecosystem. The opportunities for value creation and circulation through coopetition to operationalize CE models are nested in the aforementioned activities.

However, coordinating and incentivizing the activities that underpin coopetition presents a challenge for such complex processes. The complexity might have to be managed through decentralized and distributed systems that are secure, tamper proof, and can be tokenized. Such

decentralization resonates with the underlying ideas of distributed ledger technology, often referred to as a blockchain. A blockchain creates a secure, robust, and transparent distributed ledger able to leverage resources within a global peer-to-peer network by building algorithmic trust through smart contracts, thus representing new market design opportunities (Catalini and Gans, 2016; Davidson et al., 2016). Apart from being an information and computational technology, as a software protocol based on cryptography, a blockchain is a digital information technology for distributed databases and is best understood if it is viewed as an institutional or social technology for coordination (Davidson et al., 2016; Swan, 2015).

Once validated, transactions in the blockchain become irreversible, verifiable, permanent, and secure, thus making the use of a blockchain well suited for financial transactions (Chen, 2018). This has resulted in the creation of digital currencies that have tokenized and decentralized money (Larios-Hernández, 2017). As the technology advances, the blockchain system will expand its potential by becoming capable of tokenizing and decentralizing other assets besides money (Tapscott and Tapscott, 2016). Tokenization in the blockchain is a process of converting the rights to an asset into a digital token, which facilitates the trading of those assets and permits micropayments. Tokens can represent a wide range of assets and can be transferred without any involvement of centralized entities and can be traded on digital currency exchanges without borders (Chen, 2018; Buterin, 2014). Tokens constitute innovations to the architecture of a platform (Henderson and Clark, 1990) that incentivize its growth, operations, and its security (Catalini, 2017).

In this conceptual paper, we show how coopetition focused on value creation and appropriation can enable firms seeking to transition toward sustainable systems to operationalize the CE within diverse networks. We propose that the strategy could be incentivized by tokenizing assets in a blockchain. The applied research methodology is based on a literature review of CE, coopetition, and blockchain research. This paper contributes to CE literature by enhancing the understanding of how and why coopetition as a strategy is pertinent to firms transitioning to CE models and how tokenization could facilitate such a strategy.

The structure of the paper is as follows: The next section discusses the research methodology. The following section elaborates on the key issues of the CE by reviewing the characteristics of the CE revealed by prior research and the challenges to its implementation. The following section presents coopetition strategy as a model for structuring interaction in networks of businesses, before we

examine blockchain and tokenization and their relevance to coopetition. Next, the requirements of modern CE models and the coopetition strategy driven by tokenization on blockchain are combined into a theoretical framework before the key findings are discussed. The final section encompasses our conclusions, the study's managerial implications, and suggestions for future research.

2. Research Methodology

A literature review is an appropriate research method through which to obtain an overview of the areas in which the research topic is embedded, and also serves to highlight areas requiring more research. There are several types of literature review; the most commonly used for business studies being the systematic review, the semi-systematic review, and the integrative review (Snyder, 2019). In this study, we used an integrative review, which is suitable when the aim is to synthesize literature on a topic in an integrative way in order to create novel frameworks and perspectives. Moreover, integrative reviews suit new and unexplored research topics (Torraco, 2005).

New conceptualizations and perspectives can arise by relating literature either through differentiation or integration (MacInnis, 2011). We used and blended literature on the CE, coopetition, and blockchain in order to develop a theoretical framework that illustrates opportunities for transitions to sustainability in coopetitive networks through the use of tokens. The logic behind our choice of literature can consequently be explained by first delving into the purpose of the CE, then into the approach that is coopetition, and finally into the method of tokens in blockchains. We chose the most relevant literature in all three areas highlighting the important aspects related to the particular topic. Another criterion for our choice of literature was the potential of combining it with the other perspectives in order to arrive at a relevant theoretical framework that could be explored further in future research.

In practice, on a more detailed level, the choice of literature was guided by a process of problematizing themes and in relation to these, combining findings of prior studies to meet the aim of the study. As far as the CE is concerned, we concentrated on the literature that captures the systems view of sustainability as it is related to a network perspective, which is a core theme of

our study. Within the literature of business networks, we focused particularly on those studies related to coopetition and value creation and appropriation within coopetition. The choice was motivated by indications in traditional business network research that networks featuring coopetitive interactions can involve various types of actors (not only business ones). Our focus on value creation and appropriation was motivated by the fact that from a strategic perspective, these activities constitute the core of coopetitive interaction. Moreover, we wanted to show how value appropriation, from a CE perspective, should be transformed into value circulation using a blockchain and the tokenization of product and service information, which also represents the final part of our literature review. In that section, we chose to focus on literature that elaborates on and explains the key features of blockchain, and our combination of literature shows how tokens as tools can be used for transitions to the CE through value creation and circulation in a context of coopetition.

3. From Linear to Coopetitive Models for a Circular Economy

Problems like the ecological crisis, social inequalities, and political and economic instabilities are often articulated and thought of as discreet issues, but are actually interconnected (Lenzen et al., 2012). There is evidence linking international trade to biodiversity threats in developing countries (Lenzen et al., 2012), threats to entire species from global supply chains (Moran and Kanemoto, 2017; Wiedmann et al., 2015), and the international trading system undermining national emission targets (Kanemoto et al., 2014). The environmental impact of household consumption associated with the production and consumption of goods and services is evident (Ivanova et al., 2016), demanding a systematic approach to addressing the issue. Product and service biographies help conceptualize that impact as the products and services pass through the trading system. This perspective could also help firms visualize the CE beyond the predominant recycle-and-reuse models (Bocken et al., 2017; Murray, 2017) and open up spaces for regenerative local economic ecosystems through what Stahel (2016) describes as intelligent decentralization that offers opportunities for value creation and circulation.

3.1. The Circular Economy

Natural systems offer insights into the efficient management of resource cycles, making the concept of waste is redundant (Meadows et al., 2004). The ultimate aim of the CE is to redesign products or services from the perspective of minimal waste by allowing for easy repair or for the materials to be upgraded and reused, thus building value creation based on longevity and new forms of consumption (Schulte, 2013). MacArthur et al. (2013) define the CE as:

> An industrial system that is restorative by intention and design. It replaces the end-of-the-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models.

The interest in the CE has led to a significant number of publications, including case studies, reviews, and scientific reports (Andersen, 2007; Charonis, 2012; Preston, 2012; Prendeville et al., 2014; Bonviu, 2014; Gregson et al., 2015; Mac Arthur et al., 2015; Bocken et al., 2016; Bocken and Short, 2016). The CE models imply the adoption of cleaner production, increased producer and consumer responsibility and awareness, and the use of renewable materials and technologies while simultaneously adopting tools and policies that facilitate such use (Ghisellini et al., 2016).
Spring and Araujo (2017) illustrate how the CE perspective can be used to visualize products within a distributive network instead of the products being defined by the final producer, thus presenting entrepreneurial opportunities at various stages of the transition from specific materials and components to objects and vice versa. This view also distributes the responsibility for the final product through the entire value circle, making each entity a stakeholder in the process. This echoes the findings of Murray, Skene, and Haynes (2017) describing the CE in the context of sustainable business, which link the CE to systems thinking and the need to consider businesses as part of a wider system of stakeholders.
The objective of the CE is to redesign the linear economic models to create a circular one where waste becomes a resource, thus enabling a more equitable solution to the linear system by prioritizing balance between the economic, environmental, and social aspects (Gregson et al., 2015; Haas et al., 2015; Ghisellini et al., 2016). This implies a complex set of networks (Lieder and Rashid, 2016; Bocken et al., 2017), requiring a wider network for designing the transition

strategies. From the perspective of delivering more sustainable systems and solutions, a firm's innovation activities should be seen as dependent on the innovation activities of other firms (Aaldering et al., 2019). The literature on supply-chain management also recognizes such networks of organizations, because individual firms rarely possess the skills and resources to deliver a product's value proposition (Geissdoerfer et al., 2018). The configuration of such networks ranges from attributes like dynamic behavior, the diffusion of risks, trust, geographical dispersion and the like, to the characteristics of each organization in the network, to the product, and the type of collaboration. The collaboration aspect acquires additional relevance when sustainability is considered (see Geissdoerfer et al., 2018; Jagdev and Thoben, 2001; MacCarthy and Jayarathne, 2012). Geissdoerfer et al. (2018) have defined circular supply-chain management as the configuration and coordination of organizational functions within and across business units and organizations, implying a complex set of alignments.

The deployment of CE models and the incorporation of CE practices consequently require adjustments to current operations, realignments in supply-chain networks, and relationships based on cooperation, often with competitors (Preston, 2012). Here, a coopetition strategy to foster value creation and appropriation could make the transition to the CE both practical and attractive. Coopetition is thus a fruitful strategy to collectively build systems for sustainable innovation (Planko et al., 2016) and for transitions toward the CE.

3.2. Coopetition Strategy

The evolution of networking approaches through a continuous interactive process is a focus of business network research, which being based on interdisciplinary contributions and insights (Cantù et al., 2013), makes it uniquely placed to provide rich perspectives on the various interactions, interdependencies, conflicts, and issues related to trust currently facing CE models and to capture their evolution.

The continuous evolution in business relationships illuminates a more relational rather than strictly transactional perspective on markets and provides a broad framework for understanding how firms could visualize business models that extend beyond the market to encompass other societal spaces and institutions. Business network research has intentionally focused on change and the continuity of change as the dominant logic and feature of business relationships. Cantù et al. (2013) described

business relationships as processes of continuous adaptation in areas that include products, logistics, and administrative procedures.

The diversity of interactions and the subsequent adaptation fosters a seemingly endless organizational process that embraces economic transactions as well as social exchanges; in this context, coopetition can spur innovation processes within networks (Park et al., 2014; Gnyawali and Park, 2011). Business network research highlights the cooperative and competitive aspects of business actors and the interaction between cooperation and competition as important characteristics of the heterogeneous business landscape (Ford and Håkansson, 2013).

The notion that organizations can compete in some activities while collaborating in others is an important requirement for network efficiency (Bengtsson et al., 2005) and value-creation strategy (Dahl et al., 2016). Coopetition can facilitate sustainable solutions and situations (Reniers et al., 2010). Implementing circular models to address complex and interconnected issues requires a balance between the competitiveness that lies at the heart of business strategy (Dagnino and Padula, 2002) and collaboration. Initiating such a transition requires a transdisciplinary understanding of the issues, and managing it means implementing a process that facilitates collaborative and interdependent networks between various stakeholders while simultaneously enabling competition over the best ideas.

The concept of value creation and appropriation remains at the heart of management research (Teece, 1986; Pitelis, 2009) and is important for research on networks and alliances (Pitelis, 2012; Dyer et al., 2008). From the economic perspective, value is what consumers are willing to pay for a product or service (Brandenburger and Stuart, 1996); following this logic, value creation embraces everything that adds value to any product or service, and value appropriation encompasses all activities that capture a portion of the created value.

The coopetitive perspective emerges from the recognition that value creation and appropriation take place within the realm of inter-firm dependence, which makes way for partially convergent interests whereby cooperation and competition occur simultaneously, giving rise to a novel form of strategic interdependence among firms (Dagnino and Padula, 2002). There is a stream of coopetition research that focuses on the simultaneous existence of value creation and appropriation (e.g., Ritala and Tidström, 2014; Ritala et al., 2014; Golnam et al., 2014; Ritala et al., 2013).

In coopetitive business relationships, the creation of value occurs through the integration of complementary and similar resources that are exchanged between firms to create greater value

than each firm would have been able to create if acting alone (Bengtsson and Kock, 2000; Gnyawali and Park, 2009). In coopetitive business relationships, value creation is enhanced by competitive partners while heightening the joint understanding of business logic and technologies of the industry; this may facilitate knowledge sharing (Dussauge et al., 2000).

In comparison with value creation in coopetition, value appropriation is firm specific and may cause tensions in coopetition (Hamel, 1991; Tidström, 2009). According to Ritala and Tidström (2014), value appropriation may reduce the opportunity for other firms within the network to capture value (the zero-sum logic; Bengtsson et al., 2010; Ritala, 2009), and it may also not have an impact on other firms' abilities to capture the same or parallel value (the positive-sum logic; Choi et al., 2009; Ritala et al., 2009).

Coopetition research has highlighted relationships where actors manage value creation and appropriation within the same domain or in a shared market context, and while some studies claim that value creation takes place away from the customer and value appropriation occurs close to customers, others have illustrated that these are interconnected phenomena and evolve over time (Ritala and Tidström, 2014). This perspective injects firms with a certain level of strategic agility and becomes relevant for managing changes that are characteristic of transitions.

Digitalization (Reuter, 2016), specifically technologies like the *internet of things* and artificial intelligence that are powering industry 4.0 (see Ghoreishi and Happonen, 2019; Pagoropoulos et al., 2017; de Sousa et al., 2018) and also 3D manufacturing (Despeisse et al., 2017) are becoming more relevant in transitions to the CE. This paper specifically focuses on the importance of the blockchain as a tool for creating, organizing, and managing new forms of CE networks. Thus, a blockchain becomes the tool that coordinates these technologies by offering security, privacy, and decentralization of data and information flow within networks.

4. Blockchain and Tokens

Blockchain technology came into focus in 2008 with the emergence of Bitcoin. It has since expanded beyond cryptocurrency applications to a multitude of other commercial applications, including value and supply chains, business models, and market structures (Notheisen et al., 2017). A blockchain is a decentralized network that consists of economic agents who agree about the true

state of shared data, such a network could support multiple types of transactions online and corresponding payments, exchanges of IPs, information, or any other type of digital asset (Catalini and Gans, 2016). Such agreements happen at regular intervals, resulting in digital marketplaces that are characterized by competition, lower entry barriers, and lower privacy risks, allowing actors to collaborate in making joint investments in shared infrastructures without assigning market power to a single entity (Notheisen et al., 2017; Catalini and Gans, 2016).

A blockchain is also a new way of coordinating economic activity because the underlying technology appears to possess the institutional aspects of market capitalism, such as property rights (ledger entry and private keys), exchange mechanisms (public keys and peer-to-peer networks), native money (crypto-tokens), and finance (initial coin offerings) (Davidson et al., 2016).

In the evolution of the original Blockchain, version 1.0 addressed cryptocurrency like Bitcoin to enable the transaction of digital property, Version 2.0 assisted complex transactions like the creation of new decentralized economies and financial instruments based on *smart contracts*, and 3.0 imagined the diffusion of this distributed ledger technology, powered by decentralized principles of governance and justice, across society (Elsden et al., 2018; Swan, 2015).

Despite its inability to meet the requirements of the current financial system and governments or to match the performance of existing payment networks, Bitcoin remains one of the largest applications using a blockchain as its design solves a particular problem: allowing a global network to securely transact and exchange value while sidestepping costly intermediaries (Catalini, 2017). The underlying technology is important in that it enables digital blockchain tokens to be used to raise funds and build ecosystems by co-opting complementors, early adopters, opinion leaders, and various other stakeholders.

Entrepreneurs have built new capabilities and have begun reshaping entrepreneurship and innovation using tokens powered by blockchain technology (Chen, 2018). The resulting digital marketplaces challenge the existing revenue models of incumbents and open opportunities for new approaches to data ownership and licensing, digital advertising, incentivizing product adoption, auctions, and reputation systems (Catalini and Gans, 2016).

As a decentralized ledger with protocols, a blockchain offers an unchangeable record of transactions by combining a distributed database. A ledger is an accounting tool that records economic information such as who owns what and the agreements, contracts, and definitions that capture the value of things, as well as all transactions of value. The value could include identity,

property, contract, and value, making ledgers a fundamental instrument of modern market systems. Large central trust aggregators come at a cost along with distorted incentives (Davidson et al., 2016). A blockchain is a mechanism to prevent double-spending in the peer-to-peer electronic cash system. The database contains chronologically ordered and cryptographically interconnected blocks of transactions with a decentralized consensus mechanism and cryptographic security measures (Glaser, 2017). The combination of these elements hinders the spread of distorted or false information while moderating the friction among conflicting agents without requiring any centralized governing institution or authority (Notheisen et al., 2017).

Onik and Ahmed (2018) and Zareiyan and Korjani (2018) have discussed the possibilities that a blockchain could offer in future scenarios within industry 4.0 regimes. This could include industries based on digital enterprises with physical products at the center, with decentralized storage, augmented interfaces, and immutable crypto transactions at the end (Onik and Ahmed, 2018). Organizational models based on decentralized solutions for globalized manufacturing challenges by providing an ecosystem for manufacturers, designers, and consumers to interact efficiently without any restrictions (Zareiyan and Korjani 2018). Information about the products and services is the guiding factor in developing such interactions and will also determine how supply-chain networks could be redesigned for closing the production and consumption loops. Westerkamp et al. (2018) offered a mechanism moving beyond the current supply-chain traceability using RFID and QR codes to track goods in the blockchain and documenting their creation, transformation, and exchange on a distributed ledger.

Emerging blockchain networks designed to improve supply-chain efficiency and transparency (Francisco and Swanson, 2018; Bocek et al., 2017; Hofmann et al., 2017) offer some examples of how tokens could be deployed to create networks (Westerkamp et al., 2018). Projects such as *Waltonchain* could offer insights into designing markets through coopetition utilizing tokens. The information on *Waltonchain* facilitates the visibility of products from the beginning to the end of the production process, by connecting single or multiple chains to its public *chain cluster* ecosystem, thereby enabling the transmission and integration of data value that could potentially be traded, exchanged, or even queried to enhance that data value. Another example is provided by Nike, which with various partners has built a database accessible to designers through the *Making* application, which intends to offer freely available information to those willing to use sustainable

materials in designing their products. In doing so, Nike has distributed the responsibility for the choice of materials it uses while opening up unlimited collaboration options.

5. A Framework for Coopetition Using Tokens for Building CE Ecosystems

Openness is one of the key features of a blockchain that is designed to facilitate intra-organizational collaboration. While centralized organizations concentrate resources, distributed networks harness resources from masses of actors and in the process create open user-generated markets. In automating transactions, compliance, and trust and connecting actors, peer-to-peer blockchain systems make markets the primary mode of organization while reducing friction within economic networks (Davidson et al., 2016; Tapscott and Tapscott, 2016). Blockchain will have a considerable impact on our economic system, and economic systems are primarily about the things we value. The value embedded in the information about products and services is an important factor for organizing the production and consumption loops required for CE models. Information value depends on the use, purpose, and context of the information.

The first step towards designing the CE models would be to account for the value that is there in the system. Employing Spring and Araujo's (2017) product biography, it is possible to securely represent the resources and exchanges in the economy in an information system, enabling the exchange, analysis, distribution, verification, and alteration of these resources and exchanges. It is critical that the information accounting layer remains true to the underlying resources and the exchanges taking place in the real economy. Currently, centralized actors and institutions maintain the connection by producing accounts and vouching for the information; a distributed ledger could associate any resource with a programmable asset, effectively turning it into a token.

Tokens can represent access rights to any kind of economic value or any kind of operation in a network that results in economic value. Converting the information embedded in product biographies into tokens opens up multiple opportunities for simultaneous cooperation and competition. A major challenge related to value creation and appropriation within coopetition is the issue of knowledge and the balance between sharing and securing knowledge (Solitander and Tidström, 2010). Tokenizing elements related to coopetition would facilitate both open and shared information and also information on the creators of information. Learning and innovation between

the actors could be facilitated as valuable information would be available to all parties, and its use would be transparent.

By converting product information into openly available and accessible tokens in the blockchain, the central issue for creating value would be not information and knowledge as such but the ability to use the information. Firms would easily identify the origin of information and suitable cooperation partners to foster value creation. A critical success factor for coopetition is value appropriation, dividing the created value between the collaborating parties (Ritala and Tidström, 2014). A system of coopetition in the blockchain would facilitate the sharing and circulation of the created value as tokens show how each connected party is related to the aggregated information. Separation and/or integration are often considered as suitable strategies for managing coopetition and value creation and appropriation (e.g., Fernandez et al., 2014).

Tokens would facilitate a clear, transparent, and structured strategy for separating and/or integrating the elements related to cooperation and competition. Moreover, within a network of firms, it would be possible to create sub-networks and systems that would be based on differing principles related to the separation and integration. Coopetition could also facilitate transitions to CE-based business models particularly related to the products. Research has shown that business models based on coopetition can accelerate product development, generate a wider selection of products, and improve product quality (Velu, 2018). A framework for a token-based model of coopetition in transitions to the CE is illustrated in Figure 1.

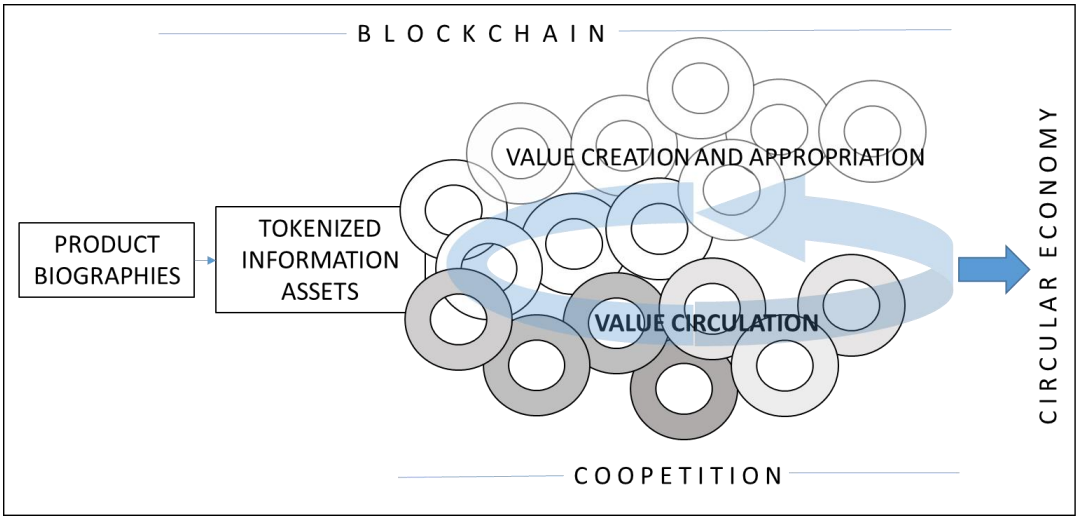

Figure 1. Transitions to the CE Using a Tokenized Model of Coopetition

It is apparent from Figure 1 that tokenized information assets related to products can be beneficial for building an ecosystem of value creation and circulation through coopetition. The openness and opportunities provided by blockchain technology could support a network and ecosystem of the CE that continuously expands and grows.

6. Discussion

The CE has both a linguistic and descriptive meaning: linguistically, it is the opposite of linear, and descriptively, the CE refers to a continuous biogeochemical cycle and recycling (Murray et al., 2017). The CE is a continuous cycle of value creation and appropriation; however, the current CE models, while attempting to dematerialize economic growth, continue to rely on an economic model for which such growth is a necessity (Skene and Murray, 2017). There is a need for concepts that can inspire ideas for creating an effective bridge between the familiar and the emergent (Narayan and Tidström, 2019).

We suggest that coopetition is such a bridging strategy, that a blockchain helps realize the cyclical continuity that is inherent to the CE, and that tokens as applications in the blockchain help manage the value creation and appropriation associated with coopetition for creating CE ecosystems. The combination of cryptography and incentives in a blockchain allows participants in the network to query and verify the state of any transaction. The blockchain thus offers market participants the ability to lower the cost of auditing transaction information while allowing new marketplaces to emerge (Catalini and Gans, 2016). We find that this attribute could extend the network of actors beyond firms to include any individual or entity that is either directly or indirectly associated with the production and consumption processes in our economic system. We also find that there are certain features of a blockchain—its ability to be open and collaborative, iterative, and transparent, see Berg, Davidson and Potts (2018)—that resonate with those associated with CE models (see Leising et al., 2018; Murray et al., 2017; Preston, 2012).

For firms attempting to make the transition to CE models, the concept of product biographies would be a good starting point (Spring and Araujo, 2017) in that the concept highlights the nature, role, and identity of products. Setting this idea in the context of the CE further challenges the stability and identity of products as CE models advocate refurbishment, remanufacturing, dismantling, reuse, and recycling, as well as being open to new forms of valuation and exchange

(Spring and Araujo, 2017). The product-biography perspective reveals new insights into a product's lifecycle in terms of its design, production, circulation, consumption or use, and disposal (Westerkamp et al., 2018). Each of these stages is supported through different networks that coordinate actors in the design, production, distribution, use, and disposal of the products (Spring and Araujo, 2017; Callon et al., 2002).

The abovementioned perspective is important because it distributes the responsibility for the product, instead of concentrating it on a single firm or actor, and in so doing makes the information relating to the contribution of value transparent, which encourages representative shares of the value created. However, managing the transition toward CE models requires the coordination of networks of actors. A decentralized ledger or blockchain could assist such coordination, and thus presents opportunities to form new types of contracts and organizations.

The shift, therefore, from a centralized system of creating consensus (using trust) to a distributed one (using blockchain technology) has the ability to transform the transactional dynamics of the modern economy. The combination of mathematical cryptography, open-source software, computer networks, and incentive mechanisms makes a blockchain a cryptographically secure and crypto-economically incentivized class of distributed ledger or a decentralized database (Swan, 2015; Davidson et al., 2016; Pilkington, 2016). Accordingly, blockchain technology becomes a natural fit for creating product biographies through the coordination of the networks of actors involved in the lifecycle of products. Every aspect of a product's lifecycle can be recorded, verified, stored, and ultimately traded, and tokens can facilitate each of these activities.

Tokens will allow individual actors to identify and define value independently and to build entire ecosystems around that value proposition through those tokens, and a strategy that combines simultaneous cooperation and competition could help actors create and appropriate value within these networks. As social interactions are embedded in these activities, we will see new forms of value emerging from such interactions that go beyond the existing forms of valued assets. This can enable actors to make the aspects of natural and social capital within individual contexts tangible. Geissdoerfer et al. (2017) have articulated the challenges involved in defining the sustainability and its relationship with CE. Within the current paradigm of consumption and production, the relationship between sustainability and CE identified by Geissdoerfer et al. (2017) remains within core business networks. By turning the lens of inquiry toward product biographies (Spring and Araujo, 2017), the networks extend beyond firms to include societal actors who become involved

at different stages of the evolution of the product. Those actors then contribute additional knowledge, dimensions, and skills that could be leveraged through coopetition to create dynamic CE models.

A current challenging issue within coopetition research is how coopetition should be managed. The literature suggests techniques for managing coopetition such as separation/integration, creating coopetition capability (Bengtsson et al., 2016), and managing tensions in coopetition (e.g., Tidström, 2014). By relying on value creation and value appropriation in coopetition, we present a novel approach for managing coopetition through the use of tokens in the blockchain. In addition, we propose that tokenizing the various activities relating to coopetition would enable a continuous process of value creation and circulation as tokens earned from one activity could be deployed for another, thus circulating the value.

The approach outlined above also facilitates the sharing of information, as well as defining its appropriate ownership which is central for the management of coopetition. Moreover, this approach encourages trust related to products within the cooperation. Prior research on coopetition has mainly addressed dyadic cooperation between competitors within different manufacturing industries (Czakon and Czernek, 2016; Gnyawali and Park, 2011) but the current study diverges in revealing how coopetition can benefit networks of various firms and related actors in their transitions to the CE.

7. Conclusion

The contribution of this conceptual study is twofold. First, it contributes to the research on transitions to CE models by introducing a strategy combining coopetition and a blockchain to direct the successful implementation of such a transition. Second, the study contributes to existing coopetition research by relating coopetition to CE models, particularly to the applications of blockchain relevant to a transition to the CE. The current research also illustrates how value creation and circulation is possible in such CE models. Thus far, coopetition research has focused on value creation and appropriation, incorporating a linear view of the value; our model presents a circular vision of value.

As far as managerial implications are concerned, our findings suggest a need for managers and businesses to explore the options for more sustainable ways of working through the transitions to

CE-based business models relying on coopetition. Competition may not be the most effective strategy to deliver competitive advantage, and the novel and productive way of doing CE-based business might well be to cooperate and compete simultaneously within a network system. Product biographies direct attention to the role of the various actors in product and service innovations and how the cost of such innovations is distributed, thereby highlighting the role of cooperation and competition for value creation and circulation. Managers might benefit from understanding and creating product and service biographies and combining digital tools to support organizing and network building to address sustainability challenges. Mapping the information related to the material and energy implicated in such biographies would be a good starting point. As those networks evolve, managerial input would focus on identifying and building collaborative networks for value creation. Product biographies distribute the responsibility for the product instead of concentrating on a single firm or actor and in doing so make transparent the information related to the contributions of value, consequently allowing the various actors to demand a representational share of the value created. By combining the secure recording of information with mechanisms for the coordination and transaction of such information, a blockchain could free up managerial resource to address the social interactions critical to network creation and consensus building that are required to promote CE business models.

A limitation of the current study is it being conceptual and based on a review of existing literature. An avenue for future research is therefore to explore our findings in an empirical study. This would include a deeper investigation of society's increasing reliance on data and how the value of data could be understood within various contexts. Further research would also be required to identify the organizational forms and strategies relevant for uncovering this nested value. Another theme for future research would be to thoroughly explore value circulation in the context of coopetitive business relationships. Coopetition research does incorporate studies on value creation and appropriation, but value circulation is a novel aspect of coopetition introduced in this paper; therefore, it would be important to explore how it can be managed and its implications for firm performance. Future research should also look at how different technologies complement each other to improve value creation and circulation and at the role of innovation in such distributed value systems.

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