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Chapter X

Blockchains for Accelerating Open Innovation Systems for Sustainability Transitions

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Abstract

Challenges related to climate change, inequality, environmental degradation, and resource scarcity threaten our ability to sustain ourselves while ensuring an equal and prosperous future. The inherent complexity and interconnectedness of these challenges demand a rethinking of our traditional approach towards organizing our production and consumption systems. Transitions towards sustainability require systemic changes, implying a wide network of actors coordinating for new forms of organizing. This chapter proposes that blockchains could offer opportunities for such organizing by leveraging the various combinations of skills, capabilities, and knowledge across open innovation networks to facilitate transitions. The characteristics of open innovation networks and their significance to blockchains are discussed, and their relevance in sustainability transitions. Democratizing access to knowledge and coding trust and consensus through smart contracts make new and innovative economic spaces and opportunities possible. Firms may have to rethink

traditional modes of organizing to seize the multiple opportunities that blockchains enabled open innovation systems present.

1.1 Introduction

Blockchain technologies offer opportunities to reinvent various categories of monetary markets, financial services, payments, and economics in addition to a highly effective model for organizing activities that could enable possibilities for reconfiguration across industries, including most areas of human activity [Swan, 2015]. Such possibilities could potentially help facilitate transitions to sustainability, for instance, through new forms of peer-production and decentralized infrastructures supporting applications such as shared economies, finance, cloud databases, and mesh networks.

Based on existing research, this chapter explores how blockchains could enable networks for open innovation. We focus on the characteristics of these open innovation networks and their contribution to sustainability transitions. By developing an understanding of the key characteristics and their relatedness to the ideas driving blockchains, this chapter addresses the relevance of such characteristics in open innovation processes guiding sustainability transitions. It proposes that blockchain technologies could play an important role in harnessing open innovation markets by radically reorganizing our production and consumption systems through decentralization; and thus enable transitions towards sustainable systems.

Sustainability transitions gain importance as societies globally face significant long-term challenges related to climate change, population, resource scarcity, food security and pollution. In addition, deepening inequality and slowing economic growth have further exposed the need for a reconsideration of the traditional models of production and consumption towards more sustainable ones. [Blok et al., 2015]. However, there are strong path-dependencies and lock-ins within the current system that resist change [Markard et al., 2012; Ahman and Nilsson, 2008; Unruh, 2000].

Established technologies are socialized through user behaviour, practices and lifestyles, aided by complimentary technologies that maintain the business models, value chains, organizational and institutional structures and regulations [Rip and Kemp, 1998]. The transition to electric vehicles where the internal combustion engine is giving way to battery technologies is not limited to the energy source but includes the sociotechnical system that supports them. The established alliances within current sociotechnical systems lean towards incremental rather than radical changes thus limiting capabilities for addressing sustainability challenges [Markard et al., 2012; Frantzeskaki and Loorbach, 2010; Dosi, 1982]. This has highlighted the need for ways and means of promoting and governing a fundamental transformation of sociotechnical systems towards sustainable modes of production and consumption.

An emerging body of literature on transitions to sustainable sociotechnical systems is contributing towards understanding the complex and multi-dimensional shifts that are necessary for societies and economies to adapt to sustainable models of production and consumption, encompassing areas like energy, transport, housing, and food [Coenen et al., 2012].

This transition process is defined by innovations that are systemic and are characterized by shifts towards sociotechnical configurations involving new technologies along with corresponding changes in markets, user practices, policy and cultural discourses, and governing institutions [Markard et al., 2012; Geels and Schot, 2010; Geels et al., 2008].

In the context of firms, this translates into navigating beyond product and process innovations towards a more systemic level of innovation that include products, services, and technologies along with new business and organizational models [Xavier et al., 2017; Adams et al., 2016; Montalvo, 2014; Boons et al., 2013], involving a wider stakeholder engagement. It is increasingly evident that such radical transitions requiring systems level innovations involving a diverse set of actors demand enabling tools for effective and efficient coordination.

There is now a growing consensus that the ideas, policies, and narratives that have traditionally defined and governed firm competitiveness are changing and this changing landscape calls for

collaborative innovation systems, as the issues are complex and interrelated [Loorbach and Wijsman, 2013]. Sustainability transitions therefore imply systemic changes requiring open innovation systems comprised of diverse actors such as businesses, research organisations, universities and governments.

Innovation is a multi-dimensional process characterized by changes in product, production process, markets, supplies/inputs, and organization [Schumpeter, 1934]. Innovation in the context of transition to sustainability needs to extend beyond economic potential to include societal changes that result from such innovation activities and the consequences for environmental and social sustainability, thus broadening both the problem framing as well as the analytical perspectives [Jacobsson and Bergek, 2011; Smith et al., 2010]. In drawing attention to the co-evolution of technology along with social networks and institutions, the innovation systems literature conceptualizes innovation as a process driven by multiple actors (Geels, 2010). Innovation conceptualized in this form, from the perspective of the firm, corresponds to the idea of open innovation.

It is important to note that in practice, openness is implicit in innovation processes, however, innovation literature makes a distinction between open and closed innovation [Huizingh, 2011]. Chesbrough [2003] used the term ‘open innovation’ as an umbrella construct that connected and integrated a range of activities, and in doing so enabled scholars and practitioners to visualize the design of innovation strategies in an increasingly networked and interconnected world [Huizingh, 2011].

Studies on open innovation offer deep insights into how firms negotiate environmental uncertainty and the complexities of innovation and knowledge recombination, and diffusion through increased organizational permeability initiated by interactions with a wide range of actors [Felin and Zenger, 2014]. This notion of innovation that encompasses diverse sets of actors has resulted in a range of alternatives ranging from contests and tournaments, to alliances and joint ventures, and corporate venture capital, licensing, open source platforms, and even participation in various development communities [Felin and Zenger, 2014]. Increase in such external linkages demonstrates improved innovation outcomes and better financial performance [Leiponen and

Helfat, 2010; Love et al., 2014]. Additionally, firms that repurpose their focus towards mitigating negative social and environmental impacts by moving beyond just optimizing individual performances could fundamentally restructure existing systems and encourage a rethink within wider networks [Loorbach and Wijsman, 2013].

Described as a ‘new paradigm for organizing activity with less friction and more efficiency’, blockchains offer global scope and scale for disintermediated transactions and automated resource allocation of physical as well as human assets [Swan, 2015]. We propose that firms that reorient themselves towards sustainable transition markets stand to gain by taking advantage of opportunities and blockchain technologies offer such firms the ability to do so. Blockchain technologies may offer alternate ways of ‘spontaneous’ organizing along with the governance properties of commons [Allen and Potts, 2016a&b; Davidson, et al., 2016] in open innovation processes directed towards solving issues related to sustainability.

More importantly, by enabling secure, end-to-end, and computationally validated transfer of value (this can be money, assets, or contractual agreements), it creates a new form of ‘algorithmic trust’ [Swan, and De Filippi, 2017], thus offering new opportunities for open innovation collaborative platforms aimed at resolving sustainability related challenges.

1.2 Open Innovation Networks for Sustainability

Transitions towards sustainable production and consumption systems require involvement of a variety of disciplines and approaches [Grin et al., 2010; Reid et al., 2010] including new business models and advanced management approaches incorporating new ways of determining business performance and success [Loorbach and Wijsman, 2013]. This means making intentional changes to the underlying philosophy and values that drive the current system; and to imagine this possibility while operating within the constraints of the incumbent system can be a daunting task [Kemp et al., 1998; Geels, 2002; Garud and Gehman, 2012; Adams et al., 2016; Bollier, 2016].

However, open innovation arenas could enable such transition processes. Technology and innovation management studies present why open innovation systems may explain how firms leverage their capabilities and appropriate value more effectively, [Gassmann et al., 2010]. Some firms have internalized the idea that the value of business models that incorporate and encourage a continuous interaction of ideas within wider networks is far greater than those that do not [Chesbrough, 2003; Chesbrough and Appleyard, 2007; Gassmann et al., 2010]. Chesbrough [2003] described this shift from a predominantly closed system to an open one as a 'paradigm shift' (in the sense of Kuhn, 1962). Industrial marketing literature has identified the various actors in such innovation processes; comprised of firms, research organisations, universities and governments, it offers insights into how these complex innovation networks should be managed [Rampersad et al., 2010]. The dynamics of such innovation processes, that include not only market introduction and social embedding, but also the extent to which existing technological capabilities and market linkages need to be changed, have been discussed as well [Abernathy and Clark, 1985; Deuten et al., 1997; Van de Ven et al., 1999; Rip and Schot, 2002; Rip, 2012].

There have been efforts [Moore et al., 2014; Seyfang and Haxeltine, 2012] to provide an understanding of innovation processes for sustainability by reflecting on the normative orientations of such processes along with social and political aspects of knowledge production and technology development. This has contributed to innovation studies by connecting innovation theory with science and technology studies (STS); resulting in the examination of interactions within socio-technical transitions [Smith, et al., 2010].

Successful open-innovation efforts require a shared initiative, a pool of incentivized individuals and the organization of individual efforts. Blockchains, by allowing untrusted networks of participants to agree on shared states for decentralized and transactional data securely without any central control or supervisor [Tasca and Tessone, 2017] facilitates new modes of transactions. It offers a layer of societal mobilization by making activities for open innovation possible through software protocols and provides an opportunity to understand its role in the socio-technical transition process towards sustainability.

1.3 Blockchain Technologies

The potential of blockchain technologies for initiating practices that go beyond payment reconciliation systems towards a value-creating paradigm implying societal benefits has been discussed widely [Böhme et al., 2015; Swan, 2015; Davidson et al., 2016; Walport, 2016; Kewell et al., 2017]. Blockchain technologies hold the promise of managing the contracts and records that define our economic, political, and social systems, through digitally engineered trust. Blockchains are open and distributed ledgers capable of recording transactions between two parties in a verifiable and permanent manner [Swan, 2015; Iansiti and Lakhani, 2017].

The potential of the blockchain can be gauged by its ability to embed contracts in digital codes that are stored in transparent and shared databases, protected from deletion, tampering, and revision. This would enable the identification, validation, storage, and sharing of all agreements, processes, tasks, and payments, thus making intermediary roles played by brokers, lawyers, and bankers, redundant.

Smart contracts on the blockchain are both defined as well as executed by the code automatically, making them autonomous, self-sufficient and decentralized [Swan, 2015]. Autonomy means that upon initiation of the contract, the initiating agent can cease any engagement with the contract, self-sufficiency offers such contracts to raise funds and allocate resources for specific activities, and decentralization means they are not dependent on any single centralized entity but distributed and self-executed across network nodes [Swan, 2015; Beck et al., 2016; Beck et al., 2017].

The true potential of the blockchain can be realized when individuals, organizations, machines, and algorithms begin freely interacting and transacting with one another with very little friction [Iansiti and Lakhani, 2017]. This is already evident from the financial industry's willingness to leverage blockchains for cost reductions and increased efficiencies in several business processes involving networks of global transactions in goods, services, and legal contracts. Blockchains enable real-time settlements, which reduce operational costs, its immutability

reduces the risk of fraud and the use of smart contracts eliminates operational errors [Tasca and Tessone, 2017].

This could have deeper implications for the structure and operation of society as current established power relationships and hierarchies could easily lose their effectiveness [Swan, 2015]. Blockchain-led innovations will have transformational effects on our social, economic, and political systems and in doing so, they could potentially create new foundational infrastructures for these systems [Swan, 2015; Iansiti and Lakhani, 2017].

Firms, within this context, could cease to be stable entities and morph into dynamic networks that will coalesce into temporary enterprises by pooling knowledge residing in millions of nodes to complete tasks and projects, or to solve problems, with limited or no centralized control. The protocols will enable cooperation, and along with smart contracts, make new economic spaces possible.

1.4 Blockchain Powered Open Innovation Platforms for Sustainability Transitions

The call for a redesign of our economic institutions within which human activities are conducted, with the right incentives for creating societal and environmental resilience, is a long standing one [Arrow et al., 1995]. Blockchains present the potential for developing the tools for creating such incentives at multiple levels through smart contracts, decentralization, and consensus [Swan, 2015].

The boundary spanning and dynamic nature of blockchains resonates with the core characteristics of open innovation. The idea of open innovation is synonymous with rapid technological change, where the challenge is to create openness to possibilities and options, and success depends on the re-combinations of these options and contribution from diverse actors [Chesbrough, 2003; Chesbrough and Appleyard, 2007]. Within this frame of reference, open innovation networks geared towards sustainability transitions would necessitate an extension of technological capabilities and market linkages that result in ecological, economic and social values in addition to economic value. This implies reframing

innovation for addressing wider challenges linked to sustainable and inclusive growth that spans beyond the boundaries of the firm.

An open innovation model incorporating economic, social and environmental aspects while engaging with diverse actors would have a distributive characteristic. The interconnectedness of the challenge amplifies the importance of all entities on the platform, thus eliminating any hierarchy in the interactions.

Firms in transition could use blockchain powered open innovation platforms for testing new ideas and models for sustainability. Such platforms would create opportunities for enacting complex interactions allowing technology to shape the development process and vice versa. This could enable problem solving not through adaption but through mobilizing collective intelligence and resources for radical new solutions, which is the core purpose of open innovation, the potential of which has remained under exploited so far [Gassmann et al., 2010].

Take the example of the open innovation platforms evolving around Circular Economy (CE), a framework that presents the potential for businesses to conceptualize economic activity along with environmental and social wellbeing in a sustainable manner [Geissdoerfer et al., 2017]. As a global partner of the Ellen Macarthur Foundation¹, a CE platform, Nike initially developed a sustainable material index in a bid to understand and manage the impact of its material consumption. Subsequently, it offered this information as a freely downloadable application, as users (designers and producers) increase their consumption of sustainable materials, the actual impact will be greater, and in addition, as more actors make the transition, the cost of these materials will fall, creating an important incentive for making the transition.

Now imagine this playing out on a blockchain and the range of product ideas and business models increase exponentially. The sustainable material index could be like an InterPlanetary File System (*IPFS is a global and always accessible filesystem that can be drawn upon for resolving any issues related to the Internet*) for anyone wanting to work with sustainable materials. Through smart contracts, Nike could license its proprietary technology or even offer consulting services for business processes and strategies. This could create an avenue for revenue generation that it can leverage to justify cutting back on selling more

products and contributing more effectively to a larger sustainability goal, that of bringing down the level of consumption in our societies. Nike, in this context, morphs into a key knowledge provider in the network, from a mere product company. Opendeskⁱⁱ is another example of an online market place that hosts independent furniture designs while connecting customers to local makers, as an alternative to mass manufacturing and shipping; it claims to build a distributed and ethical supply chain through a global maker network.

Such models are possible for sustainable food, energy, mobility, and other consumer products leveraging the enormous volumes of data generated every day. This data includes historical records, messages, videos, GPS signals, and transactions, in addition to health records, land registry, education and employment. Organisations draw insights from the collection and analysis of data to optimize decision-making, personalize services and predict future trends. Eccoⁱⁱⁱ, the Danish shoe brand is collecting data from customers in stores to explore the possibility for delivering affordable handmade bespoke shoes, for example. Further, advances in artificial intelligence (AI) is making it easier to draw relevance from disparate data sources and blockchains are becoming increasingly effective in addressing concerns related to privacy [Zyskind et al., 2015].

Being tamperproof and transparent generates trust and open up opportunities for collaborations, and decentralization of governance make blockchains effective in storing, protecting, and sharing data effectively. The ability to decentralize governance means that open innovation networks can emerge to solve issues at the micro levels while drawing resources from other parts of the network at very low costs.

As a new and evolving technology, blockchain itself is an interesting case study providing insights into the governance of innovation commons. Discovering complementary uses of new technologies reduces transaction costs and while the immediate gains from new technologies or ideas might not be visible, innovation commons hold the promise of reaping the economic benefits of the continuous information exchange and coordination. [Allen, 2017]. Therefore, blockchain is a natural ally and could be a powerful driver for open innovation platforms for sustainability transitions.

1.5 Conclusion

Blockchain technologies facilitate a new paradigm by creating decentralized currencies, smart contracts or self-executing digital contracts, and creation of intelligent assets, while enabling participatory and decentralized governance systems [Wright and De Filippi, 2015]. Blockchains have the potential for revolutionizing how we think about innovation and enable the deployment of open innovation platforms for transitions towards sustainability.

Such innovation platforms could also, influence the governance norms of the blockchain. Lessing [1999] identifies law, social norms, markets, and architecture (for example, code) as the elements that influence behaviour and norms, and calls for a larger ecosystem approach for influencing individuals, and open innovation platforms for sustainability transitions could provide such an ecosystem. Open innovation platforms could help understand and shape the blockchain governance structures and the blockchain in turn could enable these platforms to flourish.

To manage complex transition processes, we need to rethink firms as dynamic networks with various combinations of skills and knowledge capabilities. Open innovation platforms could help pool the abundance of skills, knowledge, and capabilities for powerful problem solving capacity. Open innovation networks offer creative solutions as such platforms would attract diverse groups of problem solvers and diverse groups have been known to outperform groups of high-ability problem solvers [Hong and Page, 2004]. Blockchains can provide the right tools for capturing the full potential of such open innovation platforms, but it also has the potential for affecting a far more radical change in the very way we think about our economic systems.

In playing the role of a coordination mechanism, blockchain brings down all costs and barriers related to intermediations, and in doing that, it puts an end to scarcity as the driving logic of our economic system and replaces it with abundance [Swan, 2017]. Open innovation networks facilitate the process of bringing together valuable assets and knowledge that organisations can use and learn from and blockchain helps create a financial model for doing this. As digital, decentralized, and distributed

ledgers, blockchains have the ability to store data structured by rules and validated through consensus. Through this, blockchains derive the ability to confirm identities, status, and authority thus mapping the economic and social interactions that underpin our societal networks. Opportunities emerge within these interactions and financial models could surface from unlimited combination of such opportunities.

Blockchains also guides us in conceptualizing change as a process of becoming as it shifts the focus from entities towards connections and relationships, resulting in radical changes in our traditional belief systems. The network of connections increases possibilities for creating value far more than what strategic moves alone might have provided. In the process of becoming, entities are able to explore multiple possibilities through the network of connections and leverage the same connections for making those possibilities work. There is a continuous process of pursuing possibilities and maintaining a certain level of stability as the possibilities are acted on.

Firms are commonly understood, in organizational theory, as entities that are continuously adapting to the changing environment; this perspective restricts possibilities that are activated when change is associated with becoming. The idea of becoming indicates that entities are in a state of continuous change by responding to connections with new ideas and other entities. [Nayak and Chia, 2011].

Sustainability is incredibly hard to define but such abstraction need not be problematic. Firms as part of open innovation networks powered by blockchains could continuously experiments with ideas and models for capturing opportunities in transitions to sustainability through introduction, testing and diffusion of new products, services and processes. Operationalizing these processes on blockchains through smart contracts will bring down transaction costs (Davidson et al., 2018).

An open innovation process like this would also distribute the responsibilities and benefits associated with the product or service across the value chain and this in turn will create incentives for all stakeholders to be involved in the process. The Internet democratized information but the ability of blockchains to record events, verify facts, and enforce norms helps in organizing this information for value creation at each of these levels. Decentralized governance makes this effective.

Decentralized governance is still evolving and needs reframing to include not just the rules that govern blockchains-based networks and applications but also the rules that govern the infrastructure that these networks and application depend on. There is an endeavor to induce mechanisms for self-governance, along with bottom-up and multi-stakeholder governance and as this discussion develops and matures, it will provide valuable insights for governance of open innovation networks for sustainability transition governance on blockchains.

What is being proposed here will have deep implications how we conceptualize firms and this thought echoes often within the emerging scholarship on blockchains (see Davidson et al., 2018; Swan, 2017; Swan and De Filippi, 2017). It is increasingly evident that value resides at the nodes where information is understood, processed, validated, and exchanged. We conclude that blockchains could provide the dynamic organizational capability vital for organizations intent on capturing these values, through open innovation networks for addressing the complex and interrelated societal challenges to sustainability. To do this effectively, organizations will need to decentralize themselves while collaborating and sharing far beyond their traditional comfort zones.

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ⁱⁱ <https://www.opendesk.cc>

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