

Witt, Josepha; Schoop, Mareike

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# Blockchain technology in e-business value chains

Josepha Witt<sup>1</sup> · Mareike Schoop<sup>1</sup>

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## Abstract

In electronic business (e-business), innovative technologies such as blockchain technology (BCT) have a fundamental impact on activities along the value chain. The perspective of the value chain in the context of blockchain technology has been explored, but contributions are mainly focused on supply chain management and tangible goods. Hence, the e-business domain lacks research, even though many beneficial features for service value chains and the transaction of intangible goods exist. Therefore, the current paper focuses on (1) how and why value chain activities are supported by using BCT and (2) how the stakeholder's responsibilities change for value chain activities that are affected by BCT. A multiple case analysis of four e-business cases, i.e., Theta, OpenBazaar, Presearch, and Crypviser, is conducted. Based on four ideal value chains by Wirtz (2019) (cf. 4C-Net Model), steps that depend on BCT or that are supported by BCT are outlined. By conducting a cross-case analysis, we derive eight blockchain technology propositions that enlarge the existing knowledge base.

**Keywords** Blockchain technology · Value chain · e-business · Multiple case study

**JEL Classification** O31

## Introduction

Electronic business (e-business) uses innovative information and communication technologies (ICT) in business activities and exchanges such as initiation, negotiation, and transaction of a business deal between parties (Chen, 2005; Rayport & Jaworski, 2001; Schneider, 2017; Wirtz, 2000, 2019). The Internet has had a fundamental impact on companies' organisation of activities by redistributing activities along their value chains among existing and new industry actors (Osterwalder & Pigneur, 2002). Whilst the concept of e-business already came up in the late 1990s/early 2000s (Alt & Zimmermann, 2014), new innovative technologies still arise. One such radical innovation is blockchain technology (BCT), which is predicted to change fundamentally how business is conducted (Tapscott & Tapscott, 2018).

Blockchain technology as defined by (Witt, 2021) refers to a type of distributed system that tracks data changes as peer-validated transactions, attaches them to a ledger as determined by the consensus mechanism, and replicates the ledger in a distributed network. The distributed ledger stores an immutable history of all time-stamped transactions, secured by cryptographic linkages and protected against manipulation by cryptographic techniques. A transaction on a blockchain (BC) enables to move assets, which can be any type of digitally represented value. Based on our definition, the term blockchain technology is used as a synonym of distributed ledger technology (DLT). Therefore, BCT abstracts from the technical specification of saving transactions in linked blocks; it includes a wide variety of protocols (e.g. directed a-cyclic graph) and excludes other technologies (e.g. distributed databases).

All public blockchains, i.e., those BCs where new nodes can directly join the network without read permission, share unique characteristics, such as decentralisation, immutability of transactions, integrity, pseudonymity, authenticity, availability, and redundancy (cf. Angelis & Ribeiro da Silva, 2019; Meironke et al., 2019; Morabito, 2017; Seebacher & Schüritz, 2017); further characteristics can occur, depending on the BC protocol. These unique characteristics bring many new opportunities and features such as micropayments,

Responsible Editor: Arthur Carvalho

✉ Mareike Schoop  
schoop@uni-hohenheim.de

✉ Josepha Witt  
josepha.witt@uni-hohenheim.de

<sup>1</sup> Department of Intelligent Information Systems, University of Hohenheim, Stuttgart, Germany

incentive receiving systems, autonomous transaction executions, and traceability of goods (Grover et al., 2018). Overall, there is a common agreement on improvements, e.g. saving costs, time, and efficiency, by simplifying processes (Klein et al., 2018).

Whilst such features and opportunities of blockchain technology seem promising also for e-business, it remains unclear whether this technology will have a fundamental impact on the value creation by companies observable through changes in their value chain. The value chain (originally introduced by Porter (1985)) is a tool to enhance competitive advantage. It consists of a “series of activities required to produce and deliver a product or service – that enables a company to offer unique value” (Porter, 2001, p. 11). Therefore, analysing the steps of a value chain enables an organisation to redesign its internal and external processes, as the final product is the result of a set of value-adding processes (cf. Rayport & Sviokla, 1995). Furthermore, the value chain is a tool to understand the influence of IT on organisations, as every value chain activity involves information creation, processing, or communication (cf. Porter, 2001, p. 14). Hence, the value chain perspective is even more important when aiming for competitive advantage in e-business as innovative technologies are key enablers which impact and redistribute activities along their value chains among actors (Osterwalder & Pigneur, 2002).

The research goal of our study is to determine which steps in existing e-business value chains are affected by using a blockchain in the value creation. For reasons of accessibility, we will concentrate on public blockchains as will be discussed in the “[Research Design](#)” section.

Thereby, the analysis focuses on two research questions:

1. How and why are value chain activities supported by using BCT?
2. How do the stakeholder’s responsibilities change for value chain activities affected by BCT?

These questions are crucial for organisations that aim for implementing a blockchain as well as for researchers who aim for a theoretical understanding of the potential of this new technology. As will be shown in the next section, the approach to analyse the usage of BCT in e-business from the perspective of the value chain lacks existing theory. Thus, to answer our research questions, we gather information from already implemented blockchain projects by analysing their value creating activities. Therefore, we follow an inductive methodological approach by a multiple case study (cf. “[Research design](#)” section) in the context of e-business. The theoretical sampling consists of four e-business BCT cases that use a public blockchain, namely Theta, OpenBazaar, Presearch, and Crypviser. These cases are described and analysed in the “[Results](#)” section. By comparing the

example value chains to the ideal e-business value chains (cf. Wirtz, 2019), changes due to BCT usage are assessed. Overall findings, which are case-independent, are discussed and blockchain technology propositions (BCT-Ps) are derived in the “[Discussion](#)” section.

## Related research

The perspective of the value chain (VC), introduced by Porter already in 1985, is a well-established tool and has been used before to analyse the usage of BCT. To show to which extent the VC perspective is used in the context of blockchain technology, we will first conduct a review of current literature on BCT and value chains. The aim of this review is to outline to which extent BCT usage in e-business value chains has been explored. Therefore, findings from different domains will be listed whilst e-business-related literature will be introduced in further detail.

As already determined by a study of Witt (2021), BCT contributions that explicitly use the value chain perspective are mainly domain-specific. This is what our review of the current literature confirms. The results are illustrated in Table 1 and clustered by their application domain.

Apart from being domain-specific, all contributions in Table 1 focus on the value chain of tangible goods in the field of supply chain management (SCM). The usage of BCT in SCM has been the subject of academic papers especially since 2019 (Rejeb et al., 2021). Several survey studies in this field agree on the listed application sectors in Table 1, i.e. agricultural/food applications and healthcare, and additionally outline logistics and manufacturing/production as main application sectors of BCT in SCM (Chang & Chen, 2020; Fabian Dietrich et al., 2021; Lim et al., 2021; Rejeb et al., 2021). Thereby, use cases in this field mainly aim for visibility (cf. transparency, tracking), integrity (cf. trust, traceability, fraud prevention), automation (cf. efficiency), disintermediation/orchestration, and information security (Blossey et al., 2019; Chang & Chen, 2020; Fabian Dietrich et al., 2021; Moosavi et al., 2021; Rejeb et al., 2021). A more generic analysis of how BCT disrupts and reshapes the VC activities in supply chain management and logistics is conducted by Rejeb and Karim (2020). They use Porter’s value chain framework (cf. Porter, 1985) as a basis and present theoretical BC application areas for each step.

On the one hand, the focus on supply chain management and tangible goods value chains is not surprising as BCT is known for enabling, e.g. real-time tracking and tracing of raw materials and products, IoT data collection, and the digitisation of paper-based processes (cf. Nikolakis et al., 2018; Rejeb & Karim, 2020). On the other hand, BCT also has many beneficial features for service value chains and the transaction of intangible goods as, e.g. incentive

**Table 1** Case-specific BCT literature using the value chain perspective

Application domain	Application	References
Food supply chain	Agricultural value chain	(Dey & Shekhawat, 2021; Zhao et al., 2019)
	Fishery and seafood value chain	(Blaha & Katafono, 2020; Cruz & Rosado da Cruz, 2020; Osei et al., 2021; Rejeb, 2018)
	Coffee value chain	(Miatton & Amado, 2020)
	Wine value chain	(Cordeiro & Olsen, 2021)
Healthcare	Healthcare value chain	(Cernian et al., 2020; Woodside & Amiri, 2018)
	Medical tourism value chain	(Balasubramanian et al., 2022)
	Pharmaceutical manufacturing value chain	(Liu & Cai, 2018)
Energy	Energy value chain	(Downes & Reed, 2018)
	Liquefied natural gas (LNG) value chain	(Philipp, 2020)
Forestry	Forest value chain	(Nikolakis et al., 2018)
	Botanical value chain	(Heinrich et al., 2019)
Other supply chains	Supply chain management	(Rejeb et al., 2019)
	Textiles and clothing value chain	(Alves et al., 2022)
	Manufacturing value chain	(Jæger et al., 2019)
	Construction value chain	(Rodrigo et al., 2019)

receiving systems, micro-payments, proof of existence, clearing, and settlement (cf. Grover et al., 2018; Witt & Richter, 2018). Nevertheless, current literature rarely focuses on the usage of BCT in value chains apart from the industrial context.

One study which is focused on the value chain of internet enterprises is conducted by Liu and Zhu (2018). Driven by the problems of information asymmetry and false information in the context of investment management, the study focuses on the value chain improvement of internet enterprises with smart contracts and the usage of tokens (1) as an incentive method and (2) to reconstruct the value system of enterprises. Value chain improvements are mainly based on the encouragement of customers to submit product suggestions actively and on the encouragement of employees to engage in product research, development, and effective task completion. Their encouragement is incentivised by tokens; the token distribution and customer participation are added as additional support activities to the value chain activities by Porter which are improved by smart contracts. Furthermore, tokens reflect the value of the company, which increases transparency (Liu & Zhu, 2018).

In contrast to this rather general view which is focused on support activities, the study by Pärssinen et al. (2018) is focused on the single primary activity marketing, i.e. online advertising. They present new requirements for BC-based online advertising solutions (e.g. scalability, quasi-transparency, energy efficiency) and analyse solutions accordingly and propose directions for solution development and future research (Pärssinen et al., 2018).

To the best of our knowledge, a comprehensive analysis of the primary value chain steps in the context of e-business

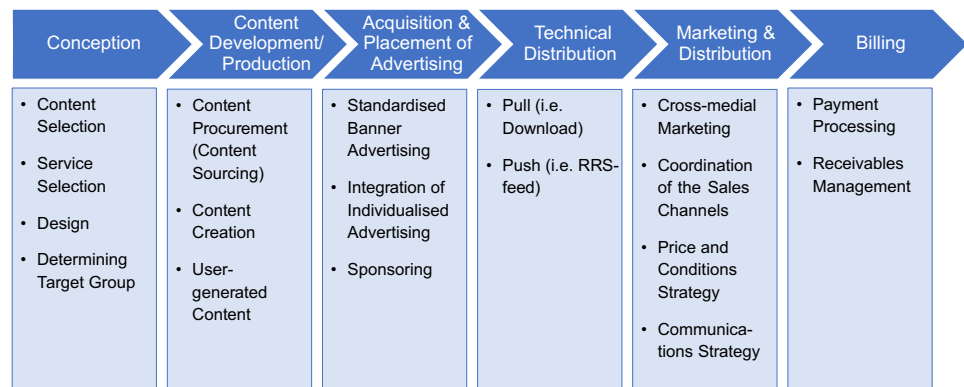
is still missing. Thus, our research goal is to determine which steps in existing e-business value chains are affected by using a blockchain in the value creation. We will focus on (1) how and why value chain activities are supported by using BCT and (2) how the stakeholder's responsibilities change for value chain activities that are affected by BCT.

## Research design

Due to the demonstrated lack of existing theory in this field, our study is conducted empirically using a multiple case study approach (cf. Eisenhardt & Graebner, 2007). To observe changes in existing value chains due to the implementation of BCT in selected cases, general value chain models are required as a basis. For this purpose, the 4C-Net Model by Wirtz (2019) is used. It consists of four business-to-consumer (B2C) e-business models, namely content, commerce, context, and connection. Each includes a generic value chain pattern consisting of value chain steps and their specification (Fig. 1).

The advantages of using this framework are manifold. Firstly, Wirtz (2019) covers multiple value chains of different business models in the framework, as similar value chains are aggregated to value chain patterns. Secondly, the value chain concept as originally introduced by Porter (1985) for manufacturing companies is already adapted to digital business models. Thirdly, the value chains are provided as patterns with additional explanations for each step. Fourthly, the value chain patterns are continuously developed by Wirtz, published in further releases (cf. Wirtz, 2010, 2018).

**Fig. 1** Value chain of the content business model (adapted from Wirtz (2018, 2019))



For each of the e-business models in the 4C-Net Model, we analyse one example case. The selection of these is restricted to cases that implement a public blockchain. Consequently, our results are more generalisable as the concepts of public and private blockchains differ and B2C value chain cases mainly use public blockchains. Furthermore, their code is open source and transactions are accessible; therefore, the case analysis is expected to be possible without the active support of organisations by only using publicly accessible information. The selection of one example for each value chain pattern comprises several steps as illustrated in Table 2.

The chosen cases for the B2C e-business models are Theta (content), OpenBazaar (commerce), Presearch (context), and Crypviser (connection).

The data collection for the analyses is based on archival sources (cf. Eisenhardt, 1989). Our inquiry approach is to gather information provided by the organisations and developers via their websites or blogs. Further information is gathered on blockchain news websites (e.g. CoinDesk,<sup>1</sup> BTC-ECO<sup>2</sup>) that provide content related to BCT (e.g. cryptocurrency prices, news about BCT projects). The rationale for our approach to inquiry is manifold. First, developers and organisations which drive these projects are the primary source of information, whilst literature, if available, records the state of the art of a project at a certain point. Second, to analyse the usage of a rapidly changing technology as BCT, gathering information from primary sources is vital.

By analysing cases, we aim to obtain a description how BCT is used in this project, i.e. we need to gather information as long as this remains unclear. Therefore, we frequently overlap data analysis with data collection; the starting points are websites and whitepapers. By overlapping these two steps, we are free to adjust the data collection process (Eisenhardt, 1989), i.e. add further archival data sources such as blogs or news articles. This approach is sufficient as

we aim “to understand each case individually and in as much depth as is feasible” (Eisenhardt, 1989, p. 539).

Detailed information about the main information sources for each case is illustrated in Table 3.

Based on this information, the cases are examined regarding their offered value, features, and technical implementation first, to understand how and why BCT is used. Afterwards, the case analyses are conducted according to the research questions. Hence, the discussion includes (1) steps in the value chains that are supported by BCT and (2) changes of responsibilities of stakeholders in the value chain. To answer the first question, the value chain steps are evaluated regarding the usage of BCT. Afterwards, the value chain patterns are extended by involved stakeholders and their responsibilities for certain steps. This is the basis to answer the second research question by comparing the stakeholder’s responsibilities when using BCT in the selected cases and outlining changes.

With this inductive approach, we take advantage of the knowledge of practitioners and document the experiences of practice (Benbasat et al., 1987). Due to the analysis of multiple cases with an appropriate level of abstraction for a cross-case analysis, we are able to generalise (Benbasat et al., 1987; Eisenhardt & Graebner, 2007) and add the findings to the existing knowledge base (Hevner et al., 2004). In case study research, this is, e.g., done by developing theoretical propositions (Yin, 2003). In this paper, we conduct a cross-case analysis of the four cases and derive blockchain technology propositions (BCT-Ps) that enlarge the current BCT knowledge base.

## Results

For each case analysis, the e-business model pattern and the related BCT case are now briefly described, thereby focusing on BCT usage. Afterwards, the usage of BCT for each step (i.e. supported by BCT or dependent on BCT) is evaluated. The comparison of the ideal value chain and the case value

<sup>1</sup> <https://www.coindesk.com/>.

<sup>2</sup> <https://www.btc-echo.de/>.

**Table 2** Case selection process

- 1 Several BCT use case collections (Essentia 1, 2018a; 2018b; MEDICI, 2016) are reviewed to collect cases. As already discussed, selected cases are restricted to B2C cases (cf. 4C-Net Model) and the usage of public blockchains (cf. accessibility). As a result, we selected 64 potential cases
- 2 Selected cases are assigned to the value chain patterns based on the description by Wirtz (2019) as we aim to analyse one case per pattern. Thereby, cases are assigned based on their application domain (e.g. a messenger service is assigned to e-connection), but independent of their technical implementation (e.g. smart contract on an existing blockchain such as Ethereum versus own blockchain implementation) as this is part of the in-depth case analysis afterwards. We assigned the following number of cases: content 18, commerce 29, context 2, and connection 15
- 3 One case for each pattern is selected based on different characteristics:
  - (a) Topicality. Cases are required to be still existent, meaning that there is an organisation/group/person hosting a website/blog/GitHub project which is still accessible to gather information which ensures a thorough analysis  
Example: EventChain (cf. smart ticketing platform), an e-commerce case, is no longer available according to their website<sup>a</sup>
  - (b) Maturity. An already implemented version of a case ensures feasibility, rather than an idea merely proposed in a white paper
  - (c) Viability. As the success of a project is not quantifiable due to a lack of measures and assumptions about the future, we aim for at least mid-term viability of cases. Therefore, we choose cases that exist for an extended period and are still further developed/supported (i.e. news or updates in the months following its publication)  
Example: LUNYR<sup>b</sup> (cf. decentralised Wikipedia), an e-content case, still exists but the last blog update was in November 2018
  - (d) Comprehensiveness. Cases which address the complete value chain are preferred to those addressing only single steps. Thereby, addressing refers to the domain level and is independent of the technical implementation (i.e. which steps are implemented by using BCT) as this is part of the in-depth case analysis afterwards  
Example for the e-commerce value chain: OpenBazaar (cf. holistic marketplace; section “Commerce Value Chain – The Case of OpenBazaar”) is favoured over Ambire AdEx<sup>c</sup> (cf. ad network)

<sup>a</sup><https://eventchain.io/><sup>b</sup><https://lunyr.com/>, <https://medium.com/lunyr><sup>c</sup><https://www.ambire.com/adex/platform>

chains including the BCT usage is illustrated in the “**Discussion**” section, which discusses the findings across specific value chains.

### Content value chain—The case of Theta

The “content business model consists of the collection, selection, systemization, compilation and delivery of content on a domestic platform [...] to make content accessible to the user over the Internet in an easy, convenient and visually appealing form” (Wirtz, 2019, p. 83). Our first selected case Theta is an example of the sub-category e-entertainment, which is characterised by having primarily entertaining content, e.g. e-games, e-movies, and e-music. One very popular example of a platform offering video content, especially user-generated video content, is YouTube. Revenues in this

business model are generated through advertisements and merchandising. The main problems of video content platforms today result from their centralised content delivery of streams to viewers via centralised content delivery networks (CDN) (Theta Labs, 2018). This can cause poor video quality and poor user experience, high infrastructure/CDN bandwidth costs, and inefficiency regarding revenue flows (Theta Labs, 2020b). One BCT-based case fighting these problems is Theta.

Theta is a P2P network for decentralised video streaming and delivery, originally focused on e-sports, powered by memory and bandwidth resources of incentivised viewers (Theta Labs, 2018). Theta itself is not a video platform as, e.g., YouTube. Instead, it provides video platforms with a new way of delivering their videos to viewers; the videos are stored centrally or streamed by content providers. Hence, the

**Table 3** Main information sources for the case analyses

Case	Main information sources
Theta (content)	Theta websites ( <a href="http://www.thetatoken.org">www.thetatoken.org</a> , <a href="http://www.theta.tv">www.theta.tv</a> ), Theta whitepaper, Theta blog, Theta community site (community.theta.tv), CoinDesk
OpenBazaar (commerce)	OpenBazaar website (openbazaar.org), OpenBazaar blog on Medium, OpenBazaar FAQ (openbazaar.zendesk.com), OpenBazaar forum (forum.openbazaar.org), BTC Echo
Presearch (context)	Presearch websites (presearch.org, engine.presearch.org), Presearch whitepaper, Presearch blog on Medium
Crypviser (connection)	Crypviser website (crypviser.network), Crypviser whitepaper, Crypviser blog on Medium



Theta Network is a decentralised content delivery network, aiming to enable a smoother, higher quality video streaming for existing or developed content platforms. Viewers act as caching nodes in the CDN, sharing their bandwidth, and are rewarded with tokens. Theta thus aims to reduce CDN costs of platforms by reducing expensive infrastructure. Furthermore, also content creators can benefit from token rewards they receive for sharing their content (Theta Labs, 2020b).

The Theta Network includes a mesh delivery network for video content and a Theta Blockchain Network to replicate and extend the underlying blockchain corresponding to the consensus mechanism. Any user can become a node, categorised in validator and guardian nodes, by locking up a certain number of tokens for a fixed time period. To incentivise and govern actions, the Theta protocol introduces two tokens to enhance the protocol security: THETA (Theta Token) and TFUEL (Theta Fuel) (Theta Labs, 2020a). THETA is used to “stake, secure and govern the Theta Network” (Theta Labs, 2018, p. 34). In contrast, TFUEL serves as an operation token, used for on-chain operations (e.g. smart contract

operations, video segment payments). It can be earned by viewers when relaying video streams to other users or by validator and guardian nodes based on the amount of THETA staked annually to become a node.

The Theta Blockchain mainnet introduces three novel concepts: (1) multi-BFT consensus mechanism (a new consensus mechanism based on Proof of Stake and Byzantine Fault Tolerance (BFT)), (2) Aggregated Signature Gossip Scheme (adapted broadcast between nodes), and (3) Off-chain Resource-Oriented Micropayment Pool (cf. Theta Labs (2018) for further information as this is not the focus of the present paper). Beside these, the Theta mainnet offers smart contracts, enabling, e.g., transparent royalty distributions, and innovative payment models.

The ideal content value chain by Wirtz (2019) consists of six steps. These steps are analysed based on their description with regard to Theta to find out which are supported by or implemented via blockchain technology, described in Fig. 2 and illustrated in Fig. 6.

**Fig. 2** Analysis of the content value chain based on Theta

Conception	<p><b>Conception is not affected by BCT usage.</b></p> <p>As Theta is a CDN, but not a video platform which offers content, the step Conception is neither supported by BCT nor dependent on BCT. Conception is primarily conducted by the platform owner, content provider, and target group who decide about offered contents independently of the CDN. New innovative revenue models might have an influence on that in the long run.</p>
Content Development/ Production	<p><b>Content Development/ Production is supported by BC-based revenue models.</b></p> <p>The Theta CDN supports any video streams without affecting the content of a video platform. Nevertheless, BCT enables new revenue models which e.g. include professional content creators (cf. MGM Studios who provide their content without selling it to THETA.tv), and Smart Contracts ensure fairly and transparently distributed royalties as a mayor benefit for content creators.</p>
Acquisition & Placement of Advertising	<p><b>Acquisition &amp; Placement of Advertising depend on BCT.</b></p> <p>BCT dependent are the rewards for users watching (extra) ads, proof-of-engagement with ads for advertisers, and direct value flow from advertisers to content creators. Furthermore, an increasing willingness of viewers to pay for services is expected, related to Thetas BC-based revenue model that rewards viewers for several activities (e.g. sharing bandwidth, watching advertisements).</p>
Technical Distribution	<p><b>Technical Distribution is fully dependent on BCT.</b></p> <p>Video content via Theta Network is consumer-to-consumer (C2C) transferred. Viewers pull content from multiple peering caching nodes without using on-chain transactions (cf. mesh delivery network). Instead, rewards of caching nodes are BCT-based, which incentivises viewers to share resources. Hence, this step is not implemented via BCT but incentivised, and therefore depends on it.</p>
Marketing & Distribution	<p><b>Marketing is supported by BCT; Distribution is dependent on BCT.</b></p> <p>BCT supports Marketing (e.g. via token incentivised referrals), but it is overall not dependent on the Theta BC (cf. cross-media marketing/ marketing mix instruments). Regarding Distribution, the access to video streams (e.g. through THETA.tv website) is not based on BCT, whilst a main part of Distribution fully depends on BCT, i.e. pricing and conditions are captured in the Theta protocol.</p>
Billing	<p><b>Billing is fully dependent on BCT.</b></p> <p>BC tokens enable transactions on a pay-per-byte granularity (cf. Theta's Off-chain Resource-Oriented Micropayment Pool) while minimising transaction costs. This enables fair and transparent revenue models for all stakeholders (cf. viewers for cashing/ads, content deliverer as gifts/subscriptions, platform provider reduce CDN costs), independent of third-party providers such as banks.</p>

## Commerce value chain—The case of OpenBazaar

A very popular e-business model is electronic commerce, which includes “the initiation, negotiation and/or settlement of transactions over the Internet” (Wirtz, 2019, p. 103). A well-known example of electronic retailing which covers all subcategories (i.e. attraction, negotiation/bargaining, payment, and delivery) is Amazon. The e-commerce business model is full of middlemen who profit from user-generated data and increase the price of products by their revenues (e.g. banks in payment processing, or marketplace provider) (OpenBazaar, n.d.). An example that faces these middlemen and implements the commerce business model using BCT is OpenBazaar.

OpenBazaar is a protocol and network for fully decentralised commerce, developed and published by the organisation OB1<sup>3</sup> (OpenBazaar, n.d.). It enables to sell and buy goods and services online (e.g. music, clothes, art, jewellery, food and beverages, and cryptocurrencies) by connecting people directly without middlemen. This results in no fees for sellers and buyers, no data collection, and no restrictions. OpenBazaar offers privacy without giving up trust, e.g. with end-to-end encrypted chats, pseudonymous identities, privacy control, and mediator involvement.

The OpenBazaar network offers three user roles: buyer, seller, and moderator. Sellers can offer single products, like individuals on eBay, or create a whole shop using OpenBazaar, thereby circumventing emerging challenges when building a centralised e-commerce store (e.g. set up an own web server or use fee-based services). Buyers and sellers are prevented from fraud by using a feature called multi-signature escrow. They have the option to choose an OpenBazaar user as a mutually trusted third party before trading, called moderator. Instead of sending the purchase price directly to the seller account, the buyer sends cryptocurrency to an escrow account. The only way to release that amount is by an agreement of two out of three parties. These are normally buyer and seller, but if a dispute appears, the moderator will settle it. This enables the prevention of fraud in an open marketplace.

To assess how BCT is used in the case of OpenBazaar, the technical implementation is briefly described as follows (OpenBazaar, n.d.). OpenBazaar is based on a decentralised network of user-operated nodes. Therefore, the usage requires to run the OpenBazaar server (i.e. network node/back-end application) and client (visual interface/front-end application). The decentralised OpenBazaar Network is built on top of the InterPlanetary File System (IPFS)<sup>4</sup> to store listings of offered goods and services. Hence, “[r]unning an OpenBazaar node is essentially running a custom IPFS

node” (OpenBazaar, 2018). Instead of relying on a centralised search engine, IPFS enables any provider to index the database freely and multiple search engines can be offered (Pesch & Ishmaev, 2019).

Neither the messaging feature nor the contractual relationships are based on BCT. The messaging protocol uses ZeroMQ as a basis (Raval, 2016) which is an open-source, universal messaging library (ZeroMQ, n.d.). Instead of relying on BC-based smart contracts, OpenBazaar uses Ricardian contracts as a signed agreement between parties, stored unalterable on a merchant’s computer (Sanchez, 2014).

BCT is used in the context of OpenBazaar for cryptocurrency payments and a smart contract-based advertising platform. For purchases on OpenBazaar, several cryptocurrencies (e.g. Bitcoin, Litecoin) are offered as a payment currency. The OpenBazaar protocol integrates a multi-currency wallet to hold different cryptocurrencies in one wallet and pay a purchase on OpenBazaar. Payment methods beside cryptocurrencies are not supported, as credit cards have several disadvantages (e.g. identity information required, fee for acceptance). Consequently, in line with the displacement of platform owners, third-party payment processors become obsolete using OpenBazaar. For the feature multisignature escrow (payment including a moderator), BCT is used, because a multisignature address is generated that relies on the unique Bitcoin public keys of the three involved parties.

As announced in 2017, OB1 aims to develop an advertising network, based on tokens and smart contracts deployed on the Ethereum Blockchain. OpenBazaar Tokens (OBT) are independent of the core functionalities of the network. Instead, tokens are used as inputs for smart contracts to add further value to network users by enabling additional features. One feature that requires tokens to initiate smart contracts is the creation of decentralised ad-spaces to monetise curated content lists. The user-driven curation is a powerful way to gain attention from buyers and increase sales. Other features could be the support of premium listings based on keywords searched (OpenBazaar, n.d.).

Whenever possible, the design of OpenBazaar and its features is built completely decentralised (cf. Streichert, 2018). Nevertheless, with regard to the ideal commerce value chain, BCT supports or implements only few steps in OpenBazaar, as described in Fig. 3 and illustrated in Fig. 6.

## Context value chain—The case of Presearch

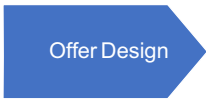



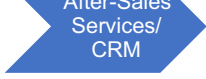
The context business model deals with the classification and systematisation of information available on the Internet. Context providers (e.g. Google Search) aid navigation on the Internet and reduce complexity rather than primarily offering own content (Wirtz, 2019). With the monopoly position of Google that controlled 87.35% of the search engine market share in 2020 (Clement, 2020), e-search is highly centralised. This

<sup>3</sup> <https://ob1.io/>.

<sup>4</sup> IPFS is a peer-to-peer distributed file system which connects all devices with the same file system, storing content available through permanent links, Benet (2019).



**Fig. 3** Analysis of the commerce value chain based on OpenBazaar

	<p><b>Offer Design is not affected by BCT.</b></p> <p>Because of OpenBazaar's decentralised nature, the assortment design is not restricted to any items (censorship-free trading); the responsibility to offer products/services only in accordance to the law is shifted from the platform owner to sellers. Hence, the Offer Design is changed by the decentralised implementation of OpenBazaar, but is not dependent on / supported by BCT.</p>
	<p><b>Offer Presentation is supported by BCT.</b></p> <p>As the user profile and store are stored locally on the OpenBazaar server, the offer presentation is done fully decentralised (cf. IPFS), but is not relying on BCT. Nevertheless, the experience design as well as the transaction security through multisignature escrow are enhanced by BCT.</p>
	<p><b>Marketing/ Transaction Initiation can be supported by BCT.</b></p> <p>Currently, activities regarding marketing, brand development (e.g. rating of users), and sales (e.g. individualized discounts) on OpenBazaar do not use BCT. It is planned to develop an ad network based on Smart Contracts and OBT, e.g. to purchase premium listings. Hence, the step Marketing/ Transaction Initiation does not rely on BCT, but can be enhanced by BCT in further releases.</p>
	<p><b>Completion/ Price-Setting is dependent on BCT.</b></p> <p>Contracts (cf. Ricardian contracts) and the price determination are not affected by BCT. In contrast, the payment is dependent on BCT (directly or moderated by an escrow account) as the only payment method is via cryptocurrencies (cf. OpenBazaar multi-currency wallet); other payment methods (e.g. credit card) are excluded as they are tied to identity, and risk identity theft.</p>
	<p><b>After-Sales Services/ CRM is not affected by BCT.</b></p> <p>As customer data is only stored on the local OpenBazaar server and therewith the customer is in full control of the own data, no possibility to analyse a huge amount of customer data exists.</p>

enables one organisation to control the flow of information for many people, resulting in two main negative effects: (1) extreme centralisation in paid advertising services, resulting in high expenses for gaining attention, and (2) extreme power and privilege in directing the traffic, many businesses are depending on (Presearch.org, 2017). One project based on BCT that addresses these problems is Presearch.<sup>5</sup>

Presearch (Presearch.org, 2017) is an open, decentralised, transparent, and community-powered search tool and engine. Searching with Presearch is twofold, offering a search tool and a search engine.<sup>6</sup> To build a community-powered search engine, the developing community has to emerge in the first place. Therefore, Presearch was incorporated as a temporary corporation, namely Presearch.org Global Limited in 2017. The corporation has undertaken an early-adopter token sale, offering Presearch token (PRE), and developed a search tool as a beta product. The search tool offers an organised collection of links out to third-party sites that are grouped by category. It acts as an additional layer, summarising search options, on top of current search engines such as Google Search or Amazon. Users can easily choose the engine they would like to search with.

When an active community exists, Presearch will transition over to a non-profit foundation, owned and controlled by the community. The fully decentralised Presearch

platform as a long-term goal is then developed by the foundation and community. Developing Presearch in a community-powered way means that any person or organisation can become a community member and is rewarded for completing actions, e.g. product development, or quality control. Rewards are paid in PRE tokens and based on the contributed value.

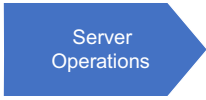




Blockchain-based PRE tokens fulfil five main purposes (Presearch.org, 2017): (1) member rewards for usage and promotion, (2) purchase of sponsorships and promotional placements, (3) partner rewards for provided traffic and visibility, (4) input on community matters, and (5) community funding of development projects. PREs are built on the Ethereum Blockchain (Presearch.org, 2020), using the token standard Ethereum ERC-20. The PRE features enabled by Ethereum cause transaction costs and times as usual for Ethereum. This makes using PREs for every transaction impractical. Hence, a non-blockchain credit system is used to track internal transactions, using Presearch credits, existing and exchanged on a one-to-one basis.

The concept of decentralisation is not only realised in the context of BC-based PRE and the decentralised community of contributors, e.g. developing the search engine. Also, the operation of servers centralised is replaced by using nodes for any kind of server (e.g. crawler nodes) and distributed data stores (i.e. IPFS) are used to store further content, as the web index.

<sup>5</sup> <https://presearch.org/>.

<sup>6</sup> <https://engine.presearch.org/>.

**Fig. 4** Analysis of the context value chain based on Presearch

	<p><b>Server Operations is dependent on BCT.</b></p> <p>The server operation itself is implemented in a decentralised manner, not using BCT. Instead, BCT is necessary for token rewards of (1) user-based crawler nodes, and (2) nodes storing the crawled data via IPFS. User-based crawler nodes perform browser-based crawling of websites while surfing via Presearch browser extension and earn PRE for the utilisation of their computer and internet connection.</p>
	<p><b>Search Software/ Algorithm is dependent on BCT.</b></p> <p>As main principles of Presearch are transparency and open code in form of an open source project, the development of search algorithms by community members requires token incentives. Specific search algorithms are developed by teams of data scientists, which are rewarded with PRE tokens when gaining more traffic by users searching.</p>
	<p><b>Sale of Advertising Forms is dependent on BCT.</b></p> <p>Ads for indirect revenues (i.e. homepage sponsorships, banners) are not based on BCT, but dependent on PRE as a payment method. This differs from keyword advertising (cf. direct revenues), priced on a cost-per-click basis by searchers on the auto-suggested link. The selection of ads is based on the amount of staked PRE; the revenue is divided between the searcher and Presearch.</p>
	<p><b>Presentation/ Contextualisation is dependent on BCT.</b></p> <p>BCT is included regarding the content curation (cf. token rewards) and in general when rewarding users for searching with Presearch. The setting of result preferences (e.g. prefer local businesses) and their presentation is not conducted using BCT, but for the encryption of preference data, the private key is required such that users are in full control of their data.</p>
	<p><b>Marketing/ Billing is dependent on BCT.</b></p> <p>Marketing includes a referral program, where Presearch can be recommended through a customised link and users earn PRE for successful referrals. Billing relates to sponsors who pay for displaying their ads, which generates direct and indirect revenues. The revenue is divided between Presearch and registered searchers who automatically receive an internal wallet to hold PRE.</p>

The ideal context value chain deployed with Presearch fully depends on BCT, as Presearch is community-based and, therefore, all step activities rely on token incentives, described in Fig. 4 and illustrated in Fig. 6.

### Connection value chain—The case of Crypviser

The connection business model “enable[s] the interaction of actors in digital networks that would not be possible in the physical world due to the prohibitively high transaction costs or communication barriers” (Wirtz, 2019, p. 137). Especially intra-connection platforms (e.g. social networks such as Facebook, user messengers such as WhatsApp) are often criticised for gathering massive amounts of users’ personal data and storing these vulnerable to leaks and cyber-attacks. End-to-end encryption as a prevention is either vulnerable for ‘man-in-the-middle’ attacks when exchanging keys via a server or requires a manual public key exchange. Even if end-to-end encryption is offered, providers will often require much personal information such as name, e-mail address, and phone number. One case that fights these problems in user messaging with the usage of BCT is Crypviser (Crypviser GmbH, 2017).

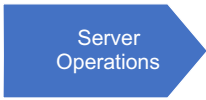


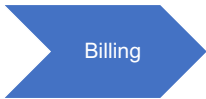
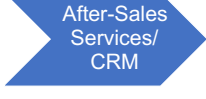
Crypviser is a solution for secure private messaging, developed and owned by Crypviser GmbH. The messenger offers true automated end-to-end encryption, relying on

decentralisation and public key distribution via BCT. Thereby, users stay anonymous, can keep conversations private, share media safely, are in control of their data, and can secure it. Beside the common functionalities of a user messenger, Crypviser offers cryptocurrency payments with the integrated money exchange feature CVPay and different further settings are provided to secure privacy (e.g. forward control).

To offer true end-to-end encrypted communication automatically, accounts are authenticated and the encryption key is exchanged based on BCT. This enables to detect and prevent any intrusion (i.e. man-in-the-middle attack) on the network level. Any in-app data stored locally (e.g. messages, pictures) is protected using a personal encryption key and passphrase (Crypviser GmbH, n.d.).

The Crypviser protocol also introduces a token, namely Crypviser Coin (CVN), that can be stored in the in-app wallet. It is used as a network currency, to charge and secure BC authentication transactions, and for anonymous money transfers between users (Crypviser GmbH, 2020). Originally, CVN was implemented on the BitShares Blockchain (enables high-performance financial smart contracts (BitShares Blockchain Foundation, 2018)); later, an ERC-20 token was created to be tradeable easily on external exchanges. A third kind of CVN token is CVT, which is only used for the Crypviser BC Network, i.e. for paying subscription plans of

**Fig. 5** Analysis of the connection value chain based on Crypviser

	<p><b>Server Operations is dependent on BCT.</b></p> <p>The server structure of Crypviser is distributed. The open source Crypviser Network consists of user-operated witness nodes (cf. miner) and registration nodes which register new accounts. Both are rewarded with BC-based CVN tokens, and therefore incentivised with the help of BCT. Hence, BCT is necessary to ensure the server operation.</p>
	<p><b>Network Infrastructure is dependent on BCT.</b></p> <p>The network infrastructure is based on the Graphene Blockchain which ensures up-to-date technology and offers secure and fast transactions. Overall, the network infrastructure is highly related to the server operation, as the servers are nodes of a distributed network, incentivised by BCT. Therefore, in this case, the two steps cannot be usefully separated.</p>
	<p><b>Marketing/ Sales is supported by BCT but does not depend on it.</b></p> <p>Marketing can be enhanced by BCT (e.g. through token incentivised referrals), but most activities are not affected by BCT usage (e.g. social media ads, free trial period). Regarding Sales, payment methods are enhanced by BCT (cf. additional CVN payments); the communication with Crypviser GmbH is possible through their marketing channels (e.g. Twitter) and not affected by BCT.</p>
	<p><b>Billing is dependent on BCT.</b></p> <p>Crypviser supports two payment methods for subscription fees, either via Google Play Store/ Apple Play Store, or via Crypviser tokens. Any payments inside the app are done with CVN and payments to users who refer Crypviser successfully are also paid using tokens. Billing is dependent of BCT as it enables one of only two offered payment methods and is required for in-app payments.</p>
	<p><b>After-Sales Services/ CRM is not affected by BCT.</b></p> <p>Crypviser does not collect any private data or assigns data to customers. Instead, different approaches to assist customers are implemented (e.g. technical support via e-mail, FAQ about the Crypviser app and Crypviser tokens). No activity of the last step uses BCT.</p>

the Crypviser messenger, or exchanging it through CVPay. CVT is not tradable, but exchanged to tradable CVN at a 1:1 rate. In the following, it is not distinguished between the different VCN tokens, as they all rely on BCT.

In the case of Crypviser, BCT is relevant for the user authentication and exchange of the encryption key (Crypviser GmbH, 2017). The BC-based authentication of public keys provides a secure user verification and prevents identity theft and thus man-in-the-middle attacks. With the BC-based public key distribution, Crypviser solves the main asymmetric cryptography challenge. Therefore, the Crypviser Network introduces two kinds of nodes for registering user and extending the BC, both incentivised through CVN. A detailed process description of the public key distribution via BCT is outlined by Crypviser GmbH (2017).

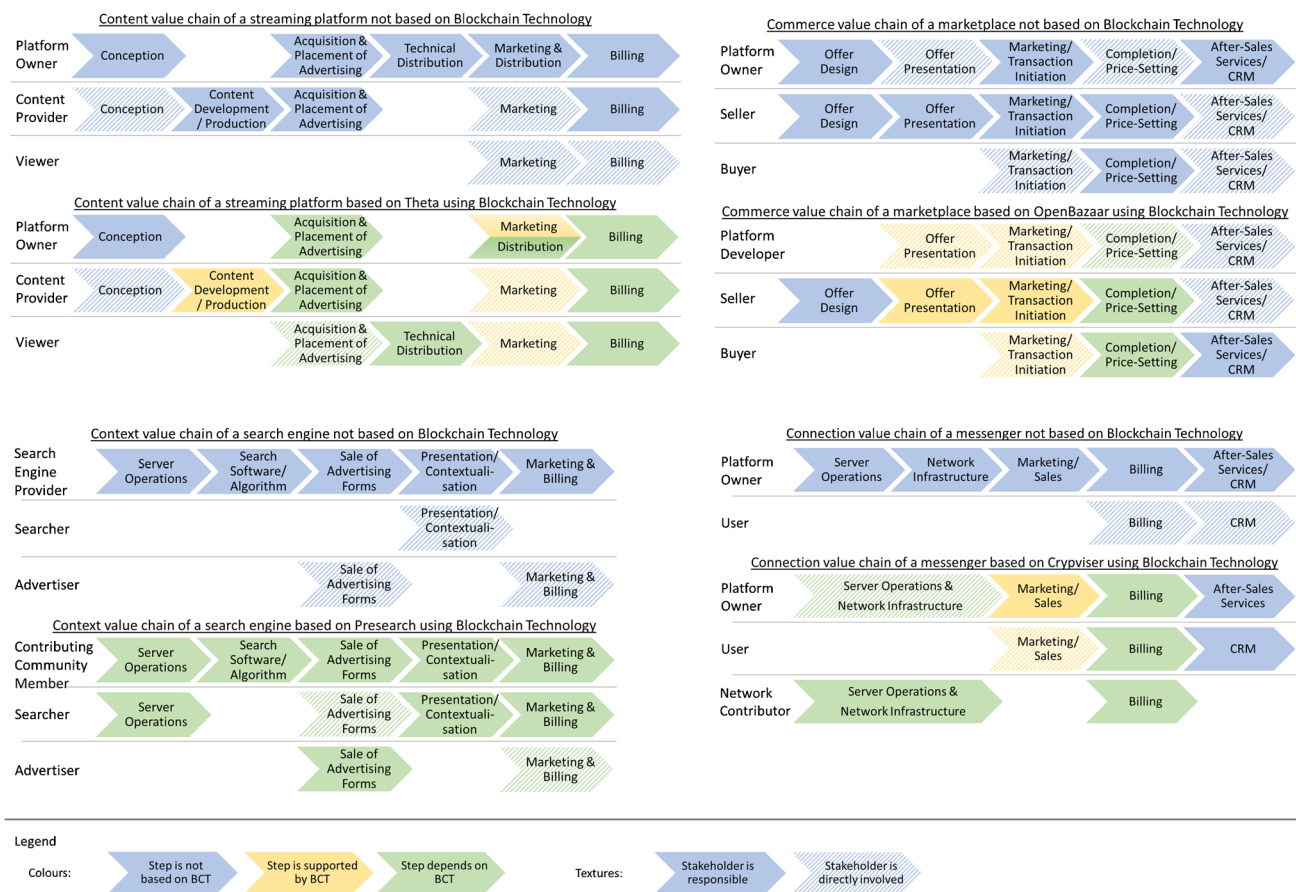
Regarding the ideal connection value chain, BCT in the case of Crypviser supports or implements most of the steps, as described in Fig. 5 and illustrated in Fig. 6.

## Discussion

Having introduced the four cases, we will now discuss them and conduct a cross-case analysis. Thereby, we are able to derive blockchain technology propositions (BCT-Ps) and discuss them referring to the literature. Our propositions can

confirm findings of previously conducted research in the field of BCT and also enlarge the current BCT knowledge base. As we have analysed cases that implement public blockchains, the BCT-Ps concern only public blockchains as well.

Before conducting the cross-case analysis from a value chain perspective, we will compare the utilised BC types mentioned before. As determined by our research design, all cases utilise public blockchains. Whilst the cases of Theta (content VC) and Crypviser (connection VC) introduce their own blockchain networks, Presearch (content VC) uses the Ethereum Blockchain for implementing their PRE tokens and smart contract. An exception is OpenBazaar that currently uses BCT only for payments and offers to pay with several cryptocurrencies. Hence, various blockchains can be the basis for payments on OpenBazaar and no further technical detail regarding the BC used can be provided. Both case-specific blockchain networks (Theta and Crypviser) are public permissioned blockchains as they are based on Proof-of-Stake consensus mechanisms. Consequently, these BC networks are tailored to their requirements, but their community has to provide nodes, etc. In contrast, Presearch relies on Ethereum, one of the most prominent public unpermissioned (whilst using Proof-of-Work since September 2022) blockchain networks.



**Fig. 6** Value chain comparison of the analysed BCT cases

Figure 6 summarises the results of our case analyses and contrasts the cases' value chains. In the following, we compare them and outline similarities and differences.

The findings regarding the first research question, i.e. *How and why are value chain activities supported by using BCT?* (answered for each case separately in the previous section), are summarised by illustrating steps supported by BCT (in yellow) and steps depending on BCT (in green). Based on those, generalised findings to the first research question are discussed in this section.

The answer to the second research question, i.e. *How do the stakeholder's responsibilities change for value chain activities affected by BCT?*, is illustrated in Fig. 6 as well. For each case, the ideal value chain and the adapted value chain are illustrated, outlining responsible and directly involved stakeholders for each step. When comparing these, changes in stakeholder's responsibilities can be derived.

Regardless of the BCT support of specific steps, the following conclusions of the analysed value chains are drawn, resulting in blockchain technology propositions. The reader should bear in mind that these BCT-Ps result from a multiple case study and, therefore, do not claim to be ontologically

true, but rather serve as observations from multiple cases that correspond and need to be explored further; they are generalised if possible.

First, the degree of BCT utilisation varies from only one step depending on BCT and two steps supported by BCT in the commerce value chain, to the full dependence of the context value chain. We conclude:

**BCT-P 1:** *The BCT usage in value chains varies from all steps depending on BCT to one step supported by BCT.*

This finding is not surprising as the complexity of BCT use cases varies from using single features BCT offers (e.g. cryptocurrencies or proof-of-existence) to holistic approaches based on BCT (e.g. decentralised autonomous organisations (DAO)) (Witt & Richter, 2018). This is confirmed by Scholz and Stein (2018) who differentiate between BCT utilisation (i.e. simple addition of BCT features) and being a BC organisation (i.e. BC-based IT infrastructure). Interestingly, our case analysis does not show a relation between the amount of VC steps supported by BCT and the BCT type (e.g. case-specific BC network).

Second, beside the context value chain, not all steps of the value chains depend on BCT or are even supported by



BCT. Hence, a full dependency of the value chain on BCT is unlikely. This was also observed when the Internet as a new information infrastructure evolved. Porter argues that “the Internet will replace certain elements of industry value chains, the complete cannibalization of the value chain will be exceedingly rare” (Porter, 2001, p. 13). This might be also the case for blockchain technology as a new information infrastructure. Nevertheless, our analysis shows that the usage of BCT can change a value chain and thereby the value creating activities completely (cf. context value chain—case of Presearch). For Presearch, which is a community-based project, BCT enables to treat all stakeholders equally and reward their contribution to the project fairly without third party dependency. Therefore, BCT is required for each step.

*BCT-P 2: BCT is able to change the value creation holistically, i.e. all value chain steps are dependent on BCT.*

As introduced in the “Related research” section, Liu and Zhu (2018) observed something similar in the value chain of internet enterprises; the usage of tokens as an incentive system for employee/customer engagement can reconstruct the value system of enterprises. Therefore, they added the activities “token distribution” and “customers participation” as additional support activities to the value chain of Porter.

Another more holistic approach by Scholz and Stein (2018) is to consider BC-based value chains as a blockchain organisation. As such, the collaboration and communication within an organisation are improved by a structural integration of BCT in the IT infrastructure, the integration in process flows, and a vision how the business model is advanced by BCT. The approach of a BCT organisation enables inter alia “to combine collective work with the decentralized value creation” (Scholz & Stein, 2018, p. 4), as realised in the case of Presearch utilising the Ethereum BC.

The high variety in the extent of BCT usage can be further explained when analysing the underlying technology. Even if all cases use a decentralised approach for the implementation of their products and services, this is not necessarily based on BCT. Several other decentralised concepts are implemented, e.g. mash networks, or IPFS for off-chain data storage.

*BCT-P 3: The degree of decentralisation does not indicate the degree of BCT utilisation.*

This finding seems straight forward but is often not reflected when talking about Blockchain Technology. A prominent example is OpenBazaar which is known a famous BC case (Bhadra, 2021; Davies, 2022). In contrast to the common claim, OpenBazaar is highly decentralised but not mainly based on BCT (e.g. using Ricardian Contracts but not BC-based Smart Contracts). Therefore, this gap (cf. BCT-P3) should be addressed in further research. Instead of only assessing if BCT is valuable (cf. Klein et al., 2018; Maull et al., 2017; Scriber, 2018), other decentralised concepts should be evaluated simultaneously. Some approaches already exist that compare the usage of BCT to alternative

technologies, as e.g. the framework by Chowdhury et al. (2018) to assess whether BCT or a central database is suitable for a certain scenario. Therefore, the BCT-P3 calls for further research on the extension of such frameworks by comparing the usage of BCT to other decentralised technologies as e.g. mash networks, IPFS, etc.

Third, most value chain steps benefit from BCT in form of token rewards, which enable new revenue models that reward all involved stakeholders. Especially users of products and services, i.e. viewers that consume content, buyers on a marketplace, searchers using an e-search, and users of connection platforms, are incentivised by token rewards and also become more responsible for value chain steps. From our case analyses we conclude:

*BCT-P 4: If BCT is used in the value creation, at least one group of stakeholders is rewarded in form of tokens.*

One reason for the pervasive usage of token rewards to incentivise value chain steps is the advantage of BCT making micropayments efficient. Payment processes usually depend on third-party providers (e.g. banks, PayPal) who charge transactions fees. These are disproportionally high in contrast to small amounts payed, and, therefore, make micropayments inefficient. Another reason is that any value contributed by a stakeholder can be reflected in tokens. This includes, e.g., shared resources, or referrals that lead to value gained by new users. Thereby, the value captured can be less than the smallest amount a fiat currency can represent (i.e. value less than 1 Euro cent). This also changes how stakeholders are perceived in the business model. For example, in the case of Presearch and the context value chain, searchers are no longer seen as a good, offered to advertisers, but as a customer that contributes value. The example of Presearch, a community-based project, lets us assume that a value creation which is completely dependent on BCT (cf. BCT-P2) makes use of new BC-based revenue models implemented with tokens. Therefore, we assume:

*BCT-P 5: If all value chain steps depend on BCT, all contributing stakeholders are rewarded in form of tokens according to new revenue models.*

This proposition fits the conclusion that BCT enables a more closely link between an organisation business model and revenue model (Michelman, 2017; Scholz & Stein, 2018). To state that this assumption (BCT-P5) is true in all contexts still needs to be confirmed or contradicted by further research. Thereby, the fact that Presearch tokens are based on a famous existing BC network (e.g. instead of implementing an own, case-specific BC network) should be reflected when analysing further cases.

Further conclusions can be drawn based on the analysis of the stakeholders. First, when comparing the stakeholders with and without BC usage for each case, a change can be determined. On the one hand, stakeholders can become obsolete as the search engine provider in the case of



Presearch (context VC). On the other hand, new stakeholders can arise when using BCT in the value creation as the network contributor in the case of Crypviser (connection VC).

**BCT-P 6:** *Stakeholders can become obsolete and new stakeholders can arise when BCT is used in the value creation.*

This BCT proposition has been observed before and is confirmed by several publications. BCT is known *inter alia* for facilitating disintermediation by cutting out middlemen (cf. Morkunas et al., 2019; Nikolakis et al., 2018). However, this is not true for each BCT case. Therefore, Feulner et al. (2022) suggest three dominating concepts: extensive disintermediation, limited disintermediation, and re-intermediation.

Apart from new and obsolete stakeholders, the responsibilities of existing stakeholders can change when BCT is used as in the case of Theta (content VC); the step technical distribution is no longer in the responsibility of the platform owner, but the viewer.

**BCT-P 7:** *BCT usage can change stakeholders' responsibilities for value chain activities.*

These changes can be accompanied with the elimination of stakeholders as in the case of OpenBazaar; the step offer design is no longer the responsibility of the platform owner. Another reason might be the emergence of new stakeholders as the network contributor in the case of Crypviser (connection VC). In the literature, BCT-P7 is controversial. Whilst Chong et al. (2019) assume that BCT adoption "only alters how stakeholders collaborate but does not usurp their roles in the value chain" (Chong et al., 2019, p. 1315), others argue that the role of intermediaries in the value chain can shift (Feulner et al., 2022; O'Dair & Beaven, 2017).

Two cases, i.e. Theta (content value chain) and Crypviser (connection value chain), still rely on a platform owner that develops the platform and makes decisions on, e.g., features. Hence, the decision making regarding strategic objectives, etc. is still centralised, even if the realisation is at least partially decentralised. Particularly noteworthy is that both cases introduce their own case-specific blockchain network,

instead of relying on an existing network as Ethereum. It remains to be investigated whether centralised platform owners tend to develop BC networks according to their needs, whilst, e.g., community projects utilise existing BC networks. The opposite is the case for OpenBazaar (commerce value chain) and Presearch (context value chain); there is no platform owner. Instead, platform developers and community members drive further development. In the case of OpenBazaar, the development is still conducted by an organisation, i.e. OB1, but offered as an open-source platform. Therefore, decisions are still made centrally, but OB1 does not own the platform and the governance on the platform is decentralised. With Presearch, also the development is fully decentralised in long-term, as the Presearch community members contribute to the further development (e.g. suggest search algorithms). Presearch's context value chain fully depends on BCT, but OpenBazaar's commerce value chain depends least on BCT, even if no platform owner exists in both cases. Therefore, we conclude:

**BCT-P 8:** *The existence of centralised platform owners is not correlated with degree of BCT utilisation.*

Research has been proven that BC-based platforms are orchestrated by new governance mechanisms which might result in no platform owner or a platform owner who gives up control over its platform (e.g. Werner & Zarnekow, 2020). Nevertheless, this may not be valid vice versa and current research lacks this perspective. Even if we assume a correlation between the existence of a platform owner and the degree of decentralisation, the correlation with the degree of BCT utilisation remains unclear (cf. BCT-P 3). To the best of our knowledge, there is no contribution that focuses on BCT-P8 and would be able to confirm or contradict our proposition. Hence, we call for further research on this topic.

Table 4 summarises all blockchain technology propositions. These propositions are derived from insights about multiple cases that correspond; they are generalised if possible as we aim for case-independent and domain-independent findings. On the one hand, this can result in observations which are not always novel in the context of BCT as some

**Table 4** BCT propositions concerning the usage of public blockchains in the value creation

BCT-P 1	The BCT usage in value chains varies from all steps depending on BCT to one step supported by BCT
BCT-P 2	BCT is able to change the value creation holistically; i.e. all value chain steps are dependent on BCT
BCT-P 3	The degree of decentralisation does not indicate the degree of BCT utilisation
BCT-P 4	If BCT is used in the value creation, at least one group of stakeholders is rewarded in the form of tokens
BCT-P 5	If all value chain steps depend on BCT, all contributing stakeholders are rewarded in the form of tokens according to new revenue models
BCT-P 6	Stakeholders can become obsolete and new stakeholders can arise when BCT is used in the value creation
BCT-P 7	BCT usage can change stakeholders' responsibilities for value chain activities
BCT-P 8	The existence of centralised platform owners is not correlated with degree of BCT utilisation

have been investigated before and are well understood in the literature (cf. BCT-P 1). Nevertheless, they are part of our findings and confirm the state of the art. On the other hand, generalising might raise new propositions (i.e. still pending to be confirmed or contradicted) which are controversial (cf. BT-P 7) or have not been proposed on a case-independent level of BCT research. One example for such is BCT-P 3: the degree of decentralisation does not indicate the degree of BCT utilisation. This aspect is neither sufficiently reflected among practitioners as the case of OpenBazaar shows, nor sufficiently investigated by researchers as this observation lacks literature that either confirms or contradicts or even discusses this finding. This said, we highlight that these propositions should not be understood as ontologically true, but rather be treated as observations that need to be critically discussed in further research.

Due to the restriction to four cases, no comprehensive analysis of individual steps can be conducted nor would a generalisation into value chain patterns be valid. Nevertheless, when reflecting upon individual value chain steps, some trends can already be derived from four cases; these trends have to be verified or contradicted after analysing more cases. First, conceptual steps are not supported by BCT (cf. *Conception* in the content value chain, *Design Offer* in the commerce value chain). This is not surprising as the conception is often based on strategic decisions, made without technical support. Another step not supported by BCT is *After-Sales Services/CRM* (cf. commerce and connection value chain). This step benefits from the decentralised nature of the platforms, which results, e.g., in storing user data locally and protecting it. Even if this step benefits from decentralisation, it is not supported by nor depends on BCT.

One step that is mainly supported but does not depend on BCT (except for the context value chain) is *Marketing*. This is the case, as BCT is used for some marketing instruments, e.g. rewards for referral marketing. Nevertheless, many other marketing instruments do not use BCT in any way. Most often included is cross-media marketing that uses several channels to communicate content to interested parties, without using BCT. An explanation of this focus might be the fact that marketing does not only address existing, but mainly potential users, who do not interact with the platform so far, i.e. use BCT. Therefore, marketing instruments reach out to users on mostly centralised platforms that are usually used. Hence, marketing activities overall can be enhanced by BCT, but the step does not depend on it. Beside these case analyses, BC-based marketing as a single activity has been investigated already in various contributions (e.g. Jain et al., 2021; Pärssinen et al., 2018).

Two steps that depend on BCT are *Server Operations/Technical Distribution* and *Billing*. *Server Operations* (cf. context and connection value chain) and *Technical Distribution* that includes the operation of servers (cf. CDN network

in the content value chain) mainly benefit from new revenue models, enabled by BCT token rewards. Consequently, users can be rewarded efficiently for sharing their resources, i.e. bandwidth. The step *Billing* also benefits from BCT tokens, as they are used as a payment medium in all value chains.

## Conclusion and outlook

In this research, we answered how and why value chain activities are supported or implemented by using a public blockchain in e-business in the case of Theta (content VC), OpenBazaar (commerce VC), Presearch (context VC), and Crypviser (connection VC). We have summarised these results and the findings on the question how stakeholder's responsibilities change for value chain activities affected by BCT in Fig. 6. In the subsequent discussion, we have derived eight blockchain technology propositions concerning public blockchains in the value creation. The BCT propositions are developed based on our case analyses and should, therefore, be treated as propositions; they remain to be confirmed or contradicted. The discussion shows that some BCT propositions are more straightforward and highly accepted in the literature already, e.g. variety in the extent of BCT usage. In contrast, others are more ambiguous, e.g. changes in stakeholders' responsibilities.

A main shortcoming of our research is to gain knowledge how BCT can be implemented from cases. On the one hand, this approach is feasible as practitioners face this question all along and the research has not answered this question sufficiently yet. Nevertheless, a case analysis comes with considerable disadvantages.

First, a case analysis can only illustrate how BCT has been used so far, but does not take the capability for further usage scenarios into account. Second, the aim to capture how BCT can be used based on cases includes the assumption that a certain case is a successful BCT case; however, successful is determined in this context. We tried to face this challenge by applying certain parameters in the case selection (i.e. maturity and continuous further development). Nevertheless, we have to confess that the case of OpenBazaar no longer exists to the extent described. The organisation OB1 ceased the development and support of OpenBazaar as the project has exhausted the capital they fund raised since 2015 (Hochstein, 2021). This shows that the shortcomings of case analyses, especially in the context of rapidly developing technologies as BCT, are not arbitrary, but need to be faced.

Further research on our research goal, i.e. to determine which steps in existing e-business value chains are affected by using a blockchain in the value creation, can be explored in various ways. First, additional cases can be analysed from a value chain perspective. On the one hand, additional cases

in the field of e-business could be analysed with the aim to compare the analyses to our findings and confirm or contradict our insights. On the other hand, the field of existing BCT use cases could be broadened by analysing cases in the field of, e.g., financial use cases. Second, our findings should be evaluated/tested, e.g. through triangulation of data collection methods by conducting interviews with experts of each analysed use case. Furthermore, we encourage researchers and practitioners to confirm or contradict our derived blockchain technology propositions so they can be generalised further in the next step. Additionally, new practical BCT cases can be introduced by practitioners to add additional insights.

Whilst the analysis of additional cases will add further insight in this field, the case of OpenBazaar shows that there is a lack on criteria that determine a successful, valuable BCT use case. Hence, the next step could also be to explore such criteria. In this context, case study research that analyses failed BCT use cases would be valuable as well to understand the drivers which lead to unsuccessful projects and need to be considered when implementing a BC project successfully. The findings of these two research fields will add value to any further research gaining insights from BCT use cases.

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