Towards a Typology of Blockchain-based Applications: A Conceptualization from a Business Perspective

Roger Heines[*], Tan Gürpinar[**]
[**]University of St. Gallen, CH-9000 St. Gallen
[**]TU Dortmund University, D-44227 Dortmund

Blockchain and other distributed ledger technologies are evolving into enabling infrastructures for innovative ICT-solutions. Numerous features, such as decentralization, programmability, and immutability of data, have led to a multitude of use cases that range from cryptocurrencies, tracking and tracing to automated business protocols or decentralized autonomous systems. For organizations that seek blockchain adoption, the overwhelming spectrum of potential application areas requires guidance reducing complexity and support the development of blockchain-based concepts. This paper introduces a classification approach to provide design and implementation guidance that goes beyond current textbook classifications. As an outcome, a typology for management and business architects is developed, before the paper concludes with an instantiation of existing use cases and a discussion of their classes.

1. Introduction

Blockchain technology (BC) represents one rising enabler with widely discussed capabilities for new types of information systems (IS) [1]. Known for the Bitcoin protocol and the underlying distributed ledger technology (DLT), this innovation provides an alternative way how transactions are digitally executed, recorded, and processed [2]. Before BC, only a centralized data management was able to ensure the validity of digital information [3]. Still, in most enterprise networks, trustworthy intermediaries are necessary to prevent the replication and manipulation of digital data. This leads to additional fees, complexity in IT-systems, security flaws as well as time consuming procedures [4].

When transferring a unique piece of digital property directly to a recipient, BC guarantees its safety and security without challenging the legitimacy of the transaction through a third party. Digital, programmable, and decentralized networks can be created with applicability to a countless number of services and processes [5], [6]. Despite many known benefits, it is still complex for companies, especially for non-technicians, to identify tangible application areas of BC for a potential adoption [7]. Where startups adopt emerging technologies much faster to create new business models, large organizations must consistently reconsider existing practices and legacy systems through a proactive identification and purposeful introduction of new technologies [8]. Although many initiatives try to establish a knowledge base, there is still a need towards a common understanding of BC for both business and IT [9].

A large number of studies and reports on use cases have been conducted and published. There is a substantial body of knowledge that mainly refers to grey literature from various sources, such as blogs, reports, and white papers [10]. There are few scientific contributions and articles that focus on a broader applicability of solutions. Some of them provide systematic literature reviews across multiple domains to conduct an overview about the current state of the art [11], [12], [13]. Others like Labazova et al. map requirements and technical features and propose a comprehensive use case overview of six areas, such as financial transactions, smart contracts, data management, storage, matching, and communication [14]. These works represent a reference point, but often lack generalizability. Also other classification schemes relate to empirical-driven taxonomies specifying technical features and trade-offs of such systems. The few theory-driven typologies are arbitrary without providing proper definitions or grounded criteria.

In order to develop a comprehensive classification scheme that is anchored in theory and provides a novel perspective on BC applicability, the paper aims to answer the following research questions:

- *RQ1: Which conceptual distinctions apply to Blockchain-based use cases?*
- *RQ2: How can Blockchain-based application areas be classified in practice?*

The remainder of this work is organized as follows. Section 2 gives a brief overview about the background and motivation of the paper highlighting the research gap and relevance. In section 3 the methodology and the development of the artifact are presented, where section 4 describes the relevant elements of the typology. Before the paper concludes with a summary and outlook in section 6, an overall discussion and an instantiation of the framework is conducted in section 5.

2. Theoretical Background

2.1. Blockchain Technology

DLT and BC are basically a new forms of database solutions that ensure the management and integrity of digitized transactions in a decentral manner [16]. The inherent technical features allow to build trust among unknown participants without the need for a third party [5], [13]. The verification process in existing structures on basis of conventional solutions represents a single point of failure and leads to time-consuming and costly reconciliation in operations that exacerbates negotiation and interaction between two entities [17].

DLT and BC replaces a single authorized ledger through a replication of records on countless nodes to shift trust from one entity towards multiple copies of a network. However, an additional decentralized mechanism is needed to manage which transactions are chosen and stored in case of a conflict. The so-called consensus algorithm determines the overall systemic state managing the propagation of transactions between equipotent peers of the network [18]. A practical concept for building trust among unknown participants has been implemented for the first time in form of the Bitcoin protocol [2]. The abilities to enable a fully public permissionless distributed ledger refers further to the immutability of data and the way information is distributed. Although DLT and BC may be implemented in various ways, the basic concept refers to four main pillars that combine years of research [2]:

- Peer-to-peer network: The topology enables the database structure for a distributed ledger and defines the network access and rights between entities in form of clients and nodes.
- Transactional logic: The protocol determines a secure communication to initiate changes and defines the distribution of records through digital signatures and additional mechanisms.
- Immutability of data: Transactions are stored and cryptographically sealed in consecutive data blocks interlinked on basis of hash functions to prior data.
- Consensus mechanism: Definition and joint execution of network rules to ensure validity and the systemic state of the network to synchronize the transactions within the shared ledger.

2.2. Decentralized Applications

Where Bitcoin was the first application that disrupted traditional payment structures, the term BC 2.0 refers broadly to the innovations beyond cryptocurrencies. Along with its evolving ecosystem, the BC 2.0 metaphor describes further the development of a whole new industry and the idea of a decentralized economy [5]. From a technical view, a comparison is often drawn to the internet and its TCP/IP protocol in terms of an underlying layer for the world wide web. This infrastructure has been used to build advanced web applications for providing internet-based services on top of it [19], [20].

As a specific feature of next generation BCs, smart contracts establish a whole new field of efficiency-driven applications. Originally relating to contractual agreements that are converted and digitized into algorithmic code, the protocol allows to automatically execute processes similar to contractual conditions. A smart contract is generally characterized by two aspects, autonomy and distribution across the network [5]. In general, a logical sequence in form of an “IF-statement” is necessary to formalize the relevant dependencies. Whether it is about automated processing in administration, invoicing for e-commerce, or machine-to-machine communication, the potentials are theoretically endless [5], [21]. Especially, the logistics sector with its supply networks and high transaction volumes is considered as a highly attractive market for these kinds of alternative ICT structures leading to a paradigm shift in the automation of interorganizational business interaction [18].

Being considered superior to conventional IS-solutions, many practitioners propose an implementation of BC and DLT for almost all sectors such as payment, transfer of voting rights, document management, supply-chain tracking, authentication services or even fully distributed autonomous organizations with an impact on many aspects in our society from environmental sustainability to healthcare or mobility [1], [22]. Based on successful pilots, many companies are encouraged to increase their involvements. More projects and partnerships are established to benefit from network effects, where the needs of the market meet demand, competition, and technical know-how. Although a return of investment is not expected in the short run, many companies take the risk to eventually benefit from improved operations, as well as better products and new business models in the future [23].

2.3. Related Work

A review of existing classifications within the IS-domain has identified a research gap that highlights the relevance for a new conceptual approach of classifying BC-based applications. Despite the growing interest of organizations, research on the applicability of BC-based solutions remains still limited [7]. Some early work provides new insight into the application design of BC-based smart contracts [24]. Other work investigates the usage of cryptocurrencies in practice [25], [26]. The focus lies either on business aspects of a specific application domain or addresses operational aspects of an implementation in a predefined industry sector [27]. Okada et al. use a classificatory approach to structure authority and incentive dimensions for joining permissionless BC-networks [28]. Ballandies et al. develop a taxonomy to map technical design features, such as cryptography and consensus, to evaluate implications on performance [29].

Where Mohsin et al. build a taxonomy on the authentication of network applications, Lemieux develops a typology on recordkeeping solutions [30], [31]. Beside a strong focus on computer science, the publications reflect only one-sided aspects of applicability [32].

Following this, Karim et al. conceptualize characteristics and applications to structure four fields of application areas on the basis of BC value propositions, namely as a development platform, smart contract utility, marketplace and as a trusted service [33]. However, the dimensions in terms of technological scope and platform access show only limited purpose for business practitioners. Also, Elsden et al. focus on a typology for BC applications by proposing seven categories. The different criteria are systematically derived from a business perspective. But in order to serve as a practical measurement tool, the proposed framework must provide a distinguishable categorization of cases [34], [14], [35]. Dependent on the target audience, the presented attributes should be easily understandable to distinguish features among application areas in practice [36]. Finally, it can be highlighted that especially grey literature provides a more comprehensive overview. Although these studies allow for a thorough understanding, the theoretical foundation is often not appropriate or missing at all.

3. Research Methodology

Different criteria can be utilized to categorize BC applications. However, there are two basic types of classifications that can be distinguished[28], [36]. Typologies are developed in a deductive manner on basis of conceptual and theory-driven work. Taxonomies are derived bottom up through inductive empirical-driven reasoning and attempt to cluster existing phenomena on basis of observable and measurable characteristics into mutually exclusive and exhaustive items [13], [36], [37]. Accordingly, it is appreciated to provide an alternative framework that does not solely rely on established variants. The tendency towards archetypal use cases and industries, such as track and tracing in logistics or payment in the financial sector, may lead to a dogmatism that inhibits a conceptualization of new interdisciplinary use cases.

Typologies, in contrast, are intended to provide a more abstract model and are characterized by two defined constructs, so called interrelated types and associated fundamental dimensions. These dimensions are based on the notion of an ideal type allowing in turn the definition of certain attributes [13]. As it appears that a theory-based classification is more aligned with the initial research objectives, the goal is to follow an approach that goes beyond an empirical analysis. By providing a new way to conceptualize BC- and DLT-based application areas, a classificatory framework in reference to the principles of typological reasoning is developed [14].

3.1. Foundations of Blockchain Technology

The proposed typology is subject to foundational implications of BC and DLT using deductive logic and reasoning. Relevant distinctions that define applicability have to be conceptually elaborated on basis of existing literature. To identify these elements, it is first necessary to describe a corpus that outlines similarities and differences in the definition of BC and DLT in terms of foundational premises (FP). In a second step, value drivers (VD) for a potential adoption of BC- and DLT-based use cases are derived by extending the work of Hofmann et al. [38]. By mapping what BC defines (FP) and why it is applied (VD), differentiated conclusions based on interdependencies between functionality and adoption can be drawn. These conclusions represent potential attributes, which are used for an instantiation of ideal types to develop a typology for BC-based applications. By addressing selected peer-reviewed-journals, conference proceedings in IS research, an explorative study on initial definitions, functionalities, and concepts of BC and DLT has been conducted.

Tab. 1: Overview of Foundational Premises

Foundational Premises	Selected References
FP1: DLT/ BC enable a distributed data storage and management	Beck et al. (2016) Dai & Vasarhelyi (2017) Hopf et al. (2018)
FP2: DLT/ BC represent a distributed computing system	Saito & Yamada (2016) Glaser (2017) Cong et al. (2017)
FP3: DLT/ BC is an IS to collect, process, store, and distribute information	Li et al. (2018) Hughes et al. (2018) Labazova (2020)
FP4: DLT/ BC enable decentralized global scale platforms and networks	Rückeshäuser (2017) Riasanow et al. (2018) Zavolokina et al. (2020)

Ultimately 37 publications have been considered to elaborate FPs that describe an underpinning theory in table 1. The exploratory study allows an aggregation of four superordinate premises. FP1 concludes all definitions describing BC as an infrastructure for value-transfer by storing and processing data in form of transactions [39], [40], [41]. FP2 extends this definition by aiming at the capabilities of BC to reach a byzantine-fault tolerance and multi-party-consensus to execute automated scripts via distributed state transitions [42], [43], [44]. Where FP3 provides an additional perspective on the IS-support of strategic, managerial, and operational activities, FP4 defines BC as a scalable platform layer for decentralized applications with the ability for autonomous process execution [45], [10], [46], [47], [48], [49]. Although the heterogonous definitions highlight the fuzzy boundaries of applicability, the conceptualized FPs serve as an initial basis for a more differentiated analysis.

3.2. A Blockchain Value Driver Perspective

Beside a functional view on BC in terms of four FPs, key value drivers are further derived from existing literature using the work of Hofmann et.al. [38]. The authors identified the transformative potentials on generic BC cases and applications to recognize the relevant domains that drive the adoption of blockchain capabilities. The findings were based on research conducted over several months, starting in June 2017, where mainly secondary sources, white papers, literature as well as websites have been acknowledged. In total, six VD were identified that represent main features of BC-based applications towards industry adoption and summarize superior characteristics to overcome pain points in existing ICT-solutions. As a result, the categories have been defined in accordance to "secure validation and protected ownership", "efficient resource allocation, scalability and interoperability", disintermediation and efficient interaction", "trusted automation of processes and contractual relations", "transparency and real-time information sharing" as well as "self-governance and democratization".

After outlining the relevant body of knowledge, it is of interest to add this perspective for a qualitative analysis and identify patterns between FPs and VDs. The goal is to allocate interdependencies and to assess the impacts of attributes on major conceptual elements. Table 2 shows the results of the evaluation, which was conducted during a focus group meeting with six representatives from the financial industry involving digital transformation managers, IT, and business architects as well as product managers. As part of a broader consortium research program on BC and DLT applications, it was not the goal to give an accurate estimation of impact levels, but rather to highlight interdependencies that offer applicable knowledge [50]. It has been revealed that different elements of the overall concept of BC address specific VD for adoption. It is possible to derive patterns and conclude relevant distinctions to develop two fundamental dimensions of the typology. Where BC represents a decentralized data storage system (FP1), the aspects for adoption strongly relate to secure validation and data protection. Defining BC as a distributed computing system (FP2), the trusted automation becomes highly relevant and extends functional capabilities beyond mere data processing. Although FP1 and FP2 partially relate to disintermediation, scalability and self-governance, transformational benefits in case of structural implications are mainly incidental driven. Accordingly, the instantiation of BC as a digital ICT structure (FP3) shows stronger implications on these kinds of drivers. The disintermediation of existing structures represents a more viable case for adoption. Where BC technology is operationalized on basis of a platform (FP4), basically all value drivers are potentially addressed.

The conceptualization of key dimensions and ideal types is based on the configurational complexity in the set of design choices between inherent technological abilities (FPs) and VDs. The analysis provides a first useful heuristic for a systematic foundation with relevant distinctions and attributes. Exhaustive and mutually exclusive classification principles can therefore be neglected to a certain extent [27].

4. A Typology of Blockchain-based Applications

4.1. Definition of Blockchain Dimensions

A need for the ideation of new application areas of BC and DLT can still be highlighted [23]. Therefore, an application-oriented classification is presented that is initially anchored in existing definitions of BC to provide useful distinctions from a business perspective. It differs from related work by determining the foundational impact and potential value proposition of BC-based applications from an industry-independent perspective. Accordingly, two dimensions are conceptualized to form a governance and process sophistication for a first differentiation. In combination with the foundational premises, an initial artefact in form a two-dimensional matrix is presented. In the following subsections the two fundamental dimensions of the typology are derived before a detailed description of classes, categories and labels takes place.

Governance sophistication

Similar to the infrastructure of the internet, BC enabled networks are created through the interconnection of data. Held on remote servers, the main difference lies in a replicated data basis, where BC is able to move the state of information directly into the system itself [43]. This global state allows to technically ensure a common, secure, and decentralized mechanism that represents the missing link for a so-called internet of value [5]. Trust is established between unknown participants in a decentralized network without the need of a third party [51]. Conventional transactions, on the contrary, are often centralized, controlled and verified through an additional instance. This verification ability is now shifted into the BC network leading to disintermediation of many structures. BC is not only capable to operate across organizational boundaries to facilitate access and transmission of transactional data, but also to exchange process states [24]. However, this architecture also leads to greater complexity. A difficulty lies in the peer-to-peer structure between equipotent participants. Its programmable logic is replicated, but in case of an error all computer nodes involved must consent to potential change. Once a BC-network is initiated, different actors have to agree upon one common protocol. Some real-world use cases show that disintermediation through BC is more relevant for certain application areas than for others. Therefore, a first dimension, the so-called governance sophistication, is introduced [52]. It refers to the level of complexity and interdependence of IT-management within organizations [53]. This understanding is extended by addressing how objectives of individual entities align to achieve economies of scale within a predefined network environment.

Process sophistication

Where the initial concept of Bitcoin lies in the disintermediation of existing monetary structures, a high governance sophistication of the system with its highly desired network effects can be observed [54]. On the contrary, the automated potential associated with smart contract functionality is much more pronounced for industry applications, such as supply chain management, digital media, or track and tracing [20]. Not dependent on required network externalities, many processes can be radically improved on basis of a decentralized business logic. The rules and instructions that are initiated by predefined code stored on the BC offer enormous potential for many businesses. The consistency of transactional data is improved by the revision-proof storage capabilities of its replicated ledger and enables an automated execution of almost all pre-and post-processing tasks [24]. Once information has been confirmed, it is documented in an audit-proof manner and can be integrated into a wide variety of contexts. From a technological point of view, BC is a predestined tool for process optimization [16]. If a video file, for example, is imported into a platform once the corresponding audio rights are automatically processed on the BC, the entire control and monitoring processes can be omitted. The range of applications may easily be extended from logistics, over administration to real-time execution in combination with internet of the things (IoT), where whole workflows are triggered to initiate self-executing autonomous tasks [55]. The technology has a variety of effects on existing processes and significantly changes the order of operations between participants in established governance structures [56], [57]. For that reason, a second dimension, the so-called process sophistication, is added to allow a categorization of application areas along attributes that aim to reduce transaction cost associated with automated execution and contracting.

Tab. 2. Interdependencies between Value Driver and Foundational Premises

(⊕: Less favorable, ⊕⊕: Favorable, ⊕⊕⊕: More favorable, ⊕⊕⊕⊕ Most favorable)

Value Driver according to Hofmann et al. (2018)		Foundational Premises: DLT/ BC enable a distributed data storage and management	DLT/ BC represent a distributed computing system	DLT/ BC is an IS to collect, process, store, and distribute information	DLT/ BC enable decentralized global scale platforms and networks
Foucs on processes	Secure validation and protected ownership	⊕⊕⊕	⊕⊕⊕⊕	⊕⊕⊕	⊕⊕⊕⊕
	Transparency and real-time information	⊕⊕	⊕⊕⊕	⊕⊕	⊕⊕⊕⊕
	Trusted automation and contractual relations	⊕	⊕⊕⊕⊕	⊕	⊕⊕⊕
Focus on structures	Disintermediation and efficient interaction	⊕	⊕⊕	⊕⊕⊕⊕	⊕⊕⊕⊕
	Direct ressource allocation, scalability & interoperability	⊕	⊕⊕	⊕⊕⊕⊕	⊕⊕⊕⊕
	Self-Governance and democratization	⊕	⊕⊕	⊕⊕⊕	⊕⊕⊕⊕

4.2. Blockchain-based Application Areas

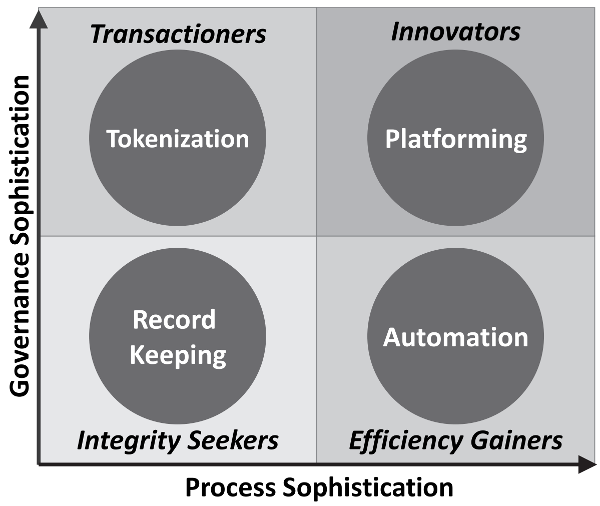

Fig. 1: A Typology of BC-based Applications

The presented typology in Fig. 1 consists of four categories and positions them across the proposed two key dimensions to group the different application areas according to their features and potentials within a 2x2 matrix. The first dimension refers to process sophistication, while the second relates to governance sophistication.

Starting with applications that are characterized by a lower degree of complexity, the grouping of BC-based solutions closes with the highest manifestation in both governance and process related attributes. With regards to the conceptual and descriptive nature of this artefact, it was not necessary to include additional sources and references.

Record Keeping

All records represented on a BC can basically be visible as well as track and traceable to all participants in the network. Every block consists of transactional data and cannot be manipulated or deleted. Only through consent of all participating nodes, a transaction might be reversed. As a result, BC allows a technical proof of data integrity based on immutability, transparency, and completeness at a certain point in time. This timestamping capability enables a wide range of documenting use cases to ensure the origin of any certificate in the area of compliance up to the automated checking of digitized records. If complete transparency is not desired, there is the possibility of a private BC to which only a limited number of users have access. The digital verification of documents or a tracking of objects held in registers represent an important economic factor. Not only auditing companies, auditors or certifiers are affected, but also manufacturers in the pursuit of their products. Companies that aim for business value in this application area can be defined as integrity seekers. Not primarily driven by network effects and scalability, an implementation results in quick and achievable benefits. Also characterized by a low level of smart contract functionality, the solution design is strongly facilitated in comparison to other application types. These use cases cover not only integrated recordkeeping systems in combination with conventional ICT, but also native on chain registries in terms of standalone platforms. However, the governance and process sophistication rise, when the recordkeeping abilities are encoded and executed among multi-stakeholder networks as part of a broader process workflow.

Automation

The technology can not only address inefficiencies in data sharing but also lead to a paradigm shift in the automation of business interaction. Conventional business process management is based on services that are handled internally within single functions and organizations. Automated business processes and workflows, on the contrary, can only be established, if a centralized repository of information is held between actors. Where a BC- and DLT-based solution creates a redundant repository through a fully distributed peer-to-peer system, multiple actors can exchange information while guaranteeing the integrity of the process. The rules and guidelines that define workflows on the BC are programmed into smart contracts in form of executable code segments. All specific steps are verified and enforced. Participants conforming with those rules can be ensured that the correct steps are being taken. This leads to a new way of seamless integration and real time auditing. Every party maintains data sovereignty without centralized control. A digitization of processes for increased efficiency strongly correlates with the complexity of smart contract functionality. Companies that seek process optimization through automated business process are defined as efficiency gainer with applications in trade finance and logistics leading the way to utilize the processual benefits of BC in form of the smart contract concept. As smart contracts are not just applications designed to perform a group of predefined functions, tasks, or activities, they represent an entirely new class of written code that spans various untrusted actors to be deployed and executed simultaneously in a distributed environment. Implementing complex smart contracts is therefore incredibly difficult and error prone that can lead to an increased process sophistication.

Tokenization

Regarding data integrity of BC, values can be stored that represent access rights, ownership of goods or intangible assets with specific characteristics to be transferred from one actor within the system to one another. This transfer capability is seen as the basis of the so-called internet of value to complement the centralized information architecture of today. Cryptocurrencies represent the most obvious applications, where ownership rights are securely and decentrally held within the ledger. A more innovative type of transaction record keeping is the so-called tokenization. It describes the digitalization of assets linking rights to real-world values for trading and settlement. Such systems differ from a native record keeping solution, as the transaction records are not only captured on chain, but enable a new digital representation of goods, rights, or services with specific characteristics in form of tradeable tokens. As the main goal lies not directly on efficiency gains through automated smart contracts, the application requires a minimal viable ecosystem in terms of network effects to ensure exchange and trade. Where cryptocurrencies, such as Bitcoins, show the ability to be interchanged with other assets of the same type, not fungible assets can be also represented through an indirect mechanism. Therefore, asset registries are linked to a digital currency on top of the BC-system. As a result, an asset can represent a piece of land, art, an old-timer, and anything else of value. Organizations that address tokenization capabilities, relate to so-called transactioners. The application area can further develop into a whole platform of copying and sharing for logging the origin and ownership of any value within a network.

Platforming

Due to the specific characteristics in terms of a distributed consensus, digital transfer of values, automation, and irreversible recordkeeping, BC has the potential to challenge entire business models of many organizations. It also offers the possibility to create new business opportunities that were not possible or not economically viable before. The features of this innovation come by design meaning that the system inheres technical elements, such as cryptography, digital signatures, and peer-to-peer architecture, that logically support the development of business platforms and ecosystems in interorganizational company networks. Like an infrastructure for the provision and processing of data-driven business models, so called BC-enabled ecosystems constitute a next step in digitization to access new markets and to provide the foundation for a decentralized platform economy. The distributed consensus replaces the role of a trusted third party and ensures that all participants are not constrained by any central authority. As any business ecosystem requires to generate value for its users and customers, BC-enabled ecosystems achieve superior benefits through high structural as well as processual implications. Platforming allows to create marketplaces to directly match sellers and buyers allowing them to automate transactions through smart contracts. The open and scalable environment allows truly integrated peer-to-peer platforms for the shared economy where consumers increasingly become prosumers with no governing authority for providing accessible, disintermediated interaction. As the operationalization of these platforms is a fluent process, other application areas can easily develop into such infrastructures if the criteria for a minimal viable ecosystem are met. Due to many stakeholders and the high relevance of smart contract functionality in terms of a required business logic between many equipotent participants, an implementation comes with significant complexity. However, organization that strive for BC enabled platforms are defined as highly disruptive innovators.

5. Discussion

An investigation of industries that apply BC indicates that different characteristics of this innovation repetitively appear and show relevance for a scheme of interrelated application fields. Where tracking and tracing of products in logistics strongly relies on recordkeeping capabilities, analogies can be drawn to the retail sector where the origin of products within the value chain is also identified on basis of immutable and transparent transactional data. However, many empirical artifacts solely provide a one-sided perspective by grouping use cases according to their industry specific scope. This often leads to inconsistent classification attributes, such as financial or non-financial categories to name a few. The decisive aspect is that BC is of great relevance for many areas outside the financial sector and others than cryptocurrencies. To eliminate these redundancies and limitations, a deductive approach based on the classificatory principles by Meyer is chosen to explore new scenarios for applicability and to provide a new strategic tool for practitioners on basis of technological capabilities [14]. By Applying the concept of abstraction and theoretical grounding on the foundations of BC, the typology introduces why and how BC is addressed to allow a positioning with regards to governance and process sophistication.

It turns out that different types of solutions differently impact existing structures and processes leading to essential conceptual similarities for the conventional digital representation of economic transactions used today. From a practitioner's viewpoint, these similarities can be also interpreted as the initial motive to apply this technology, whether it is for recordkeeping, tokenization, automation, or the creation of BC-based ecosystems. Although, these categories can be understood as static and isolated groups, their attributes dynamically change. For instance, a recordkeeping solution within a minimal viable ecosystem of universities validating the origin of certificates. This system can slowly evolve into a multi stakeholder platform that includes other entities, such as companies and agencies, to check diplomas in application processes. In this case, the framework should rather provide an indication for an application area, than to provide an accurate categorization. The two-dimensioned based frame of reference provides an underlying logic that reduces the complexity and helps to simplify the vast field of BC-based use cases.

Tab. 3: Instantiation of BC-based Applications

	Record Keeping	Automation	Tokenization	Platforming
Cryptocurrencies	-	-	10	2
Asset Management	1	1	4	-
Custody	-	-	4	-
Token Issuance	-	-	5	-
Smart Contracts	-	3	-	-
Data Management	3	-	-	-
Reporting	2	-	-	-
Banking Infrastructure	-	2	-	2
Identity Management	-	1	-	4
Total in %	**14%**	**16%**	**52%**	**18%**

To exemplify the typology, the four classes are initially applied to characterize a sample of Swiss BC and DLT-FinTechs in Tab. 3. The data was retrieved from Crunchbase where the search for "Blockchain", "Distributed Ledger" and "FinTech" resulted in 47 hits. Through a website desk research, individual service offerings have been analyzed, grouped, and mapped according to the predefined categories. If multiple services are offered, only core services are considered. Three FinTechs have been further omitted due to indefinable use cases. Interestingly, more than 50% percent of all offerings in Switzerland relate to tokenization. Only 18% specialize on platforming, whereas 16% focus on process optimization. Record keeping solutions are also underrepresented with 14%, assuming that these applications strongly compete with conventional ICT. According to the complexity of BC-solutions, it must be considered that exhaustive and mutually exclusive classification principles have been neglected to a certain extent. Although the findings probably reflect an industry specific focus and indicate application areas in a specific domain, the practicability of this framework has further to be validated through a broader empirical-to-conceptual iteration in various industries.

6. Conclusion and Outlook

This work provides a typology for BC-based applications across two dimensions and four categories, as it explains why and how use cases can be approached. On basis of a brief study, a research gap has been addressed to provide an orientation and guideline to better understand applicability from a business perspective. As such, it contributes to the existing body of knowledge within the BC domain serving as a strategic and conceptual tool for the development and implementation of new BC solutions in organizations. By addressing which useful distinctions can be applied to classify use cases into application areas, the overall research question has been answered through the definition of two attributes. Where governance sophistication aims at applications that initially impact structures in terms of disintermediation, process automation is mainly driven by solutions that primarily gear towards BCs smart contract functionality in terms of an effective process redesign. As a combination of BCs ability to affect both, processes and structures, a two-dimensional framework has been elaborated. Eventually, four categories have been defined, namely recordkeeping, tokenization, automation, and platforming. By introducing a comprehensible, compact, and easy to use strategic tool for decision making that is anchored in existing theory, a knowledge gap for academia at the intersection of disruptive potentials and real-world use cases for practice can be closed. In the context of this work, an extensive validation is still outstanding. As this initial frame of reference reduces the complexity in the vast field of BC-applications, validation is pivotal to improve potential ambiguity and inconsistencies between the categories. Apart from the formal verification using existing theories and definitions of BC in the existing literature, further testing is appreciated with focus groups and various blockchain implementations that exist. Therefore, it cannot be claimed that the proposed classification is complete nor stops the need for further research at this intersection. Nevertheless, it can be stated by non-digital experts that the artefact enables people to discuss the topic and supports the initial purpose. Following this, it provides a first reference point and represents an important step to understand and formalize use cases in a new way to explore scenarios that are not dependent on existing variants anymore.

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