DON'T SLIP ON THE INITIAL COIN OFFERING (ICO) – A TAXONOMY FOR A BLOCKCHAIN-ENABLED FORM OF CROWDFUNDING

Research paper

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Abstract

Blockchain is rapidly evolving and there is an increasing interest in the technology in both practice and academia. Recently, a blockchain use case called Initial Coin Offering (ICO) draws a lot of attention. ICO is a novel form of crowdfunding that utilizes blockchain tokens to allow for truly peer-to-peer investments. Although, more than 4.5 billion USD have been invested via ICOs, the phenomenon is poorly understood. Scientific research lacks a structured classification of ICOs to provide further insights into their characteristics. We bridge this gap by developing a taxonomy based on real-world ICO cases, related literature, and expert interviews. Further, we derive and discuss prevailing ICO archetypes. Our findings contribute to theory development in the field of ICOs by enriching the descriptive knowledge, identifying design options, deriving ICO archetypes, and laying the foundation for further research. Additionally, our research provides several benefits for practitioners. Our proposed taxonomy illustrates that there is no one-size-fits-all model of ICOs and might support the decision-making process of start-ups, investors and regulators. The proposed ICO archetypes indicate how common ICOs are designed and thus might serves as best practices. Finally, our analysis indicates that ICOs represent a valid alternative to traditional crowdfunding approaches.

Keywords: Blockchain, Smart Contract, Initial Coin Offering (ICO), Token, Token Sales, Cryptocurrency, Crowdfunding, Taxonomy.

1 Introduction

Blockchain is a recent form of distributed ledger technology (DLT) enabling decentralized and transactional data sharing across a network of untrusted participants, that has emerged with the development of Bitcoin in 2008 (Fanning and Centers, 2016; Nakamoto, 2008). The first generation of blockchains focused on creating the basis for cryptocurrencies such as Bitcoin, which is the native cryptographic token of the corresponding blockchain (Brenig et al., 2016). From a technical perspective, these tokens serve as a unit of account and are either used for the facilitation of transactions or verification procedures (Glaser and Bezzenberger, 2015). A second generation of blockchains, such as Ethereum, additionally provides a general-purpose programmable infrastructure that enables programs that can be deployed and run on a blockchain, known as smart contracts (Glaser, 2017; Xu et al., 2017). Smart contracts enable more complex programmable transactions and can be used to control digital assets, to implement a trust-free trade of assets and to facilitate the issuance of digital on-chain tokens on top of a blockchain network that can act as sub-currencies (Beck et al., 2016; Buterin, 2014, 2016). Recently, driven by the relatively simple way to create tokens via the use of smart contracts, new use cases for tokens like giving token holders access to applications or services or grant rights to participate in a platforms development emerged (Conley, 2017). Tokens have also been successfully used as a new and innovative form of crowdfunding for start-ups to raise early financing, raising a total of 250 million USD in 2016 alone and a cumulative funding of 4,518.94 million USD by November 2017 (Coindesk, 2017; Smith and Crown, 2017). Crowdfunding can be described as an open call for capital mainly via the Internet, where a campaign can be evaluated and supported by a large group of individuals, the crowd (Danmayr, 2014). While for crowdfunding in the classical sense, the matchmaking process between campaign creators and potential investors is mainly established by crowdfunding platforms serving as intermediaries, crowdfunding based on blockchain tokens relies on Peer-to-Peer interactions (Haas et al., 2014; Shin, 2017b). The rise of this new phenomenon of publicly offering tokens for sale as a way of financing has not been hidden from regulators. The US Securities and Exchange Commission (SEC) states in a recently published report that *"[…] individuals and entities increasingly are using distributed ledger technology to offer and sell instruments […] to raise capital" (Securities and Exchange Commission, 2017, p. 10)*. This young, emerging phenomenon is widely known and discussed as Initial Coin Offering (ICO) (Coinbase, 2016; Securities and Exchange Commission, 2017).

Although, there is a rapidly rising interest in ICOs from private and institutional investors, as well as capital seeking start-ups, ICOs are poorly understood, and scientific research is scarce (Kuo Chuen et al., 2017; Shin, 2017a). Further, regulators struggle to keep up with the rapid innovation and have taken various actions ranging from banning ICOs completely to keeping the market unregulated or treating only ICOs that fulfil specific criteria (Securities and Exchange Commission, 2017). In addition, ICOs are far from being standardized and can be considered very heterogeneous – in the words of the Estonian Financial Supervisory Authority (EFSA) *"every ICO is unique and should be assessed on its own characteristics"* (EFSA, 2017). Given these facts, ICO is a technology-driven phenomenon having impact on multiple fields of research and practice like blockchain, crowdfunding, and IT architecture, thus needs to be addressed by Information System (IS) research. Yet, a systematic understanding of what exactly constitutes an ICO is missing but necessary to establish a common knowledge base in Information System research that might serve as starting point for further research on success criteria and best practices. To address this lack of research, we define the following research question:

What are the design parameters of Initial Coin Offerings as novel approaches of crowdfunding?

We seek to bridge this research gap and answer our research question by developing a general taxonomy of empirically validated ICO design parameters. This approach has been taken several times in recent years and proven its applicability in blockchain research (Glaser and Bezzenberger, 2015; Xu et al., 2017). Since, taxonomies as frameworks are well suited to lay the groundwork for emergent fields of research and serve as the first step into systematizing the emerging research domain (Williams et al., 2008), we follow the established and well-recognized taxonomy development method proposed by Nickerson et al. (2013). In the development process, we utilize both literature and empirically verified knowledge. From a conceptual perspective, we draw on literature describing well-understood processes such as auction mechanisms or research on crowdfunding (Becker, 2001; Danmayr, 2014; Mollick, 2014). The empirical perspective is represented through 52 real-world ICO cases and 7 semi-structured expert interviews with practitioners and researchers involved in ICOs. With our taxonomy, we strive for the following theoretical contributions and practical implications. We aim at creating a scientific artefact that contributes to the descriptive knowledge of the young research domain concerning ICOs and, thus, laying the foundation for further research and higher-theory in the area (Gregor, 2006). Further, we pursue to enable practitioners, as well as future researchers in the fields of IS and Finance alike, to get a systematic understanding of the emergent phenomenon and the associated consequences.

After this introduction, in Section 2, we briefly explore the development of ICOs as an emergent phenomenon as well as the overarching areas of blockchain technology, cryptocurrencies, smart contracts, tokens, and crowdfunding. Subsequently, in Section 3, we explain our research method. We devote Section 4 to the application of the research method and actual development of the taxonomy. In Section 5, we present the resulting taxonomy and apply taxonomy-based cluster analysis to identify prevailing

ICO archetypes in detail. Finally, we discuss the implications and limitations as well as the practical contribution and explore further research opportunities in the concluding Section 6.

2 Foundation

2.1 Blockchain and Smart Contracts

Blockchain is a computer protocol for decentralized and transactional data sharing across a large network of untrusted participants (Xu et al., 2017). Blockchain not only enables new forms of distributed software architectures, but also introduces a wide range of use cases for the tokens associated with it, ranging from distributed virtual currency, called cryptocurrencies, to asset representation or digital rights management on the blockchain (Conley, 2017; Nærland et al., 2017). Public interest in the first generation of blockchain technology itself was sparked only when its role as the basis for cryptocurrencies was discovered with the publication of the original Bitcoin whitepaper by Satoshi Nakamoto in 2008 (Nakamoto, 2008; Zohar, 2015). A second generation of blockchain protocols such as the Ethereum blockchain, that comes with a built-in Turing-complete programming language, additionally provide a general-purpose programmable infrastructure enabling the use of smart contracts (Buterin, 2014). Smart contracts, a concept first introduced by Nick Szabo in 1994, describe a computerized transaction protocol that executes terms of a contract whereby it helps to minimize the need for trusted intermediaries and transaction costs (Szabo, 1994). In the context of blockchain technology, smart contracts refer to programs that are executed on a blockchain, allowing parties that not necessarily know and trust each other to securely transact with each other as the correct execution of these programs is enforced by a consensus protocol (Beck et al., 2016; Glaser, 2017; Sillaber and Waltl, 2017). Smart contracts enable programmable transactions and can be used to control digital assets, implement a trust-free trade of assets and to facilitate the issuance of tokens or ”sub-currencies” on top of a blockchain, also called ”on-chain tokens” (Buterin, 2014, 2016; Nærland et al., 2017).

2.2 Tokens and Cryptocurrencies

While the word "token" has a multitude of meanings, it can be defined as *"a piece resembling a coin issued as money by some person or body other than a de jure government"* (Merriam-Webster, 2017). Using tokens as some form of money is not new, as a case from Mexico City in 1776 shows, were more than 2,000 shopkeepers issued metal tokens called tlaco (Evans, 2014). We use the term token when referring to the usage of digital tokens in the context of blockchain. Viewed from a technical perspective, tokens can be used in several cases, such as the facilitation of transactions, as an internal unit of account, for the verification of block-writing, or for more creative use uses such as helping to prevent unintended use of the blockchain and to grant token holders certain types of privileged access (Conley, 2017; Glaser and Bezzenberger, 2015; Schweizer et al., 2017). It is important to distinguish between native tokens inherent to a blockchain – so called protocol tokens – on the one hand and on-chain tokens issued on top of a blockchain using smart contracts, sometimes also called app coins or app tokens on the other hand (Buterin, 2014; Johnston et al., 2017; Kuo Chuen et al., 2017; Rauchs and Hileman, 2017).

Before the advent of the second generation of blockchains and the invention of smart contracts that enable on-chain token systems, the use of tokens was basically limited to the role of cryptocurrencies (Buterin, 2014). Cryptocurrency, a subgroup of virtual currency, is a particular type of digital token, which typically functions as a medium of exchange, a unit of account, or a store of value (Monetary Authority of Singapore, 2017). Tokens don't necessarily have to be designed to play a currency-like role to qualify as virtual currency in a broad sense. They only need to be used as a value that substitutes for currency according to the definition of the US Financial Crimes Enforcement Network (van Valkenburgh, 2017b). While cryptocurrencies, such as Bitcoin as mentioned above, are a fairly recent phenomenon, its predecessors, such as the virtual currency eCash, have been around since the 1990s (Harvey, 2016). Thus, the European Central Bank (ECB) uses the umbrella-term "virtual currency schemes" and distinguishes e-money which is issued by a centralized unit, such as eCash or Second Life's Linden Dollar, from cryptocurrencies, which are issued in a decentralized manner using blockchain technology (ECB, 2015). Like central bank issued currencies, cryptocurrencies and tokens alike, unofficially follow the ISO 4217 norm, a standard that delineates currency designators (Swendseid, 2016). Following the naming convention for supranational currencies, they use 3-letter combinations such as "BTC" (short for Bitcoin) to appear more trustworthy (Swendseid, 2016). While cryptocurrencies have a shorter settlement period compared to traditional fiat currencies such as Euro or US-Dollar, according to the ECB they lack transparency, experience high volatility and a high amount of credit, liquidity, legal and operational risks (ECB, 2015; Juri, 2015). Yet, two years after the ECB report was issued, over 1,000 cryptocurrencies have been launched and are traded with a total market capitalization of more than 200 billion USD (Kelly, 2017).

Aside from cryptocurrencies, on-chain tokens created by smart contracts have a much broader spectrum of functions such as asset tokens or usage tokens (Buterin, 2014). While asset tokens are a cryptographic representation of traditional assets, such as gold, equity or fiat currency, usage tokens provide access to digital services (Tomaino, 2017). The most prominent enabler of on-chain tokens is the Ethereum blockchain, where a standard called "ERC20" for issuing tokens using smart contracts exists, which is commonly used among token creators (Vogelsteller, 2015). The distribution of these tokens can be facilitated through a variety of ways. Usually, as a giveaway to developers, a portion of the tokens created is set aside for developers working on a certain project. Another possibility used in a few cases is to credit tokens to holders of existing cryptocurrencies for free, a process called airdrop (van Valkenburgh, 2017a). A more sophisticated approach of distributing native blockchain tokens inherent to a blockchain relying on a so-called proof-of-work algorithm is by mining, a resource-intensive process where cryptographic puzzles are computationally solved, and the community is incentivized to contribute computational resources to a project. Finally crowdfunding – a process called Initial Coin Offering – can be used to distribute token against payment (Conley, 2017; Johnston et al., 2017).

2.3 Crowdfunding

With the advent of the Web 2.0 paradigm, which has enabled internet users to participate and collaborate online, new forms of peer-to-peer finance, like crowdsourcing emerged (Moenninghoff and Wieandt, 2013). Crowdsourcing is defined as the acquisition of any resource such as services, creative content or funds from a large group that is typically online (Pelizzon et al., 2016). Crowdfunding, a term which was introduced in 2006 by Michael Sullivan, is a sub-area of crowdsourcing and peer-to-peer finance, that represents a novel financing segment for consumers and small businesses (Moenninghoff and Wieandt, 2013; Pelizzon et al., 2016). By allowing a crowd to assess the economic potential of a product, company or project, it utilizes the wisdom of the crowd (Danmayr, 2014; Mollick, 2014). Thus, crowdfunding can be defined as *"a collective effort by people who network and pool their money together, usually via the internet, in order to invest in and support efforts initiated by other people or organizations."* (Ordanini et al., 2011, p. 1). Before the invention of crowdfunding, accessibility of finance was highly concentrated in a few areas, where both entrepreneurs and venture capitalists could be found. Online crowdfunding is able to drive the geographic dispersion of financiers of small, early stage projects as communication by means of the internet is relatively inexpensive (Agrawal et al., 2010; Danmayr, 2014). Due to wide differences in national regulations, however, it is far away from becoming truly global (Moenninghoff and Wieandt, 2013). Assessing the status of crowdfunding, Danmayr (2014) found that there are still several hurdles related to cross-border activities. Furthermore, crowdfunding that is facilitated via web platforms heavily relies on trusted third parties, as the majority of crowdfunding platforms operates on top of traditional financing mechanisms, such as banks and payment service providers (Haas et al., 2015; Schweizer et al., 2017).

2.4 From Crowdfunding to Initial Coin Offering

While the sale of tokens in general could be facilitated without the use of a blockchain or crowdfunding, the combinations of the two enables a completely new phenomenon: Initial Coin Offering. The abbreviation ICO bears some resemblance to IPO (Initial Public Offering), yet their structures and processes differ in many aspects such as underwriting, distribution and regulation (Ellis et al., 1999; Kuo Chuen, 2017). The phenomenon was first titled *"The Bitcoin Model for Crowdfunding"* in the year 2014 and described as a new business model for open source software, where any participant of a blockchain protocol can participate anonymously in the funding, development and revenue collection using tokens (Ravikant, 2014). This entirely new business model, which is completely decentralized as it relies solely on peer-to-peer mechanisms, represents a stark contrast to crowdfunding in the traditional sense, where the matchmaking process between campaign creators and potential investors is often established by crowdfunding platforms and banks serving as intermediary (Danmayr, 2014; Ehrsam, 2016; Haas et al., 2015; Schweizer et al., 2017). ICOs are completely open and enable a global base of investors to participate. However, a factor that negatively affects the global reach is the limited access to cryptocurrencies, which are in most cases required to invest. The limited access is primarily imposed by regulations of exchanges relying on legal restrictions and the need to perform lengthy customer background checks. Although the majority of ICOs focuses on investments through cryptocurrencies, the tokens sold in an ICO can represent a much broader spectrum of functions than the launch of a new cryptocurrency. The rationale behind ICOs differs and different types of tokens such as asset tokens or usage tokens can be sold. Currently ICOs are used to fund the development of blockchain-related projects such as new protocols or apps enabled by smart contracts in advance, even before the actual start of the project (Ehrsam, 2016; Kuo Chuen et al., 2017). According to the venture capitalist Ehrsam, the ICO model of funding projects in advance can also help to overcome the classic "chicken and egg" problem for networks. As the distribution of tokens gives users partial ownership in a network, it incentivizes potential users to join the network early to profit from a potential appreciation of the token price (Ehrsam, 2016). The ICO process typically looks as follows: In a first step, developers release a whitepaper that describes the program or protocol, its features, and its implementation. Afterwards, in a second step, they conduct a presale, often limited to large investors or people close to the project team. In a third step, the actual ICO takes place at a preannounced date where the public can purchase tokens in order to participate in the project and in some cases, have a stake in the project (Johnston et al., 2017; Kuo Chuen et al., 2017). As we indicate above, this new form of crowdfunding differs significantly from former constellations and has its distinct characteristics. To better understand the emerging phenomenon scientific research is required. For the systemization of such phenomenon taxonomy development has proven its efficacy and serves as the first step into emerging research domains (Miller and Roth, 1994; Wand et al., 1995).

3 Method

In this paper, we develop a taxonomy to answer our research question and to conduct a first step towards systematizing the emerging research domain of ICOs. A taxonomy can be considered as the result of a design science research approach and, thus, be viewed as an artefact that consists of dimensions containing characteristics that are mutually exclusive and collectively exhaustive (Nickerson et al., 2010). According to Glass and Vessey (1995), taxonomy development refers to a method of "assigning members to categories in a complete and unambiguous way". We deliberately chose the term taxonomy over alternatives such as framework or typology, as it is the most widely used among the scientific community (Nickerson et al., 2013). The purpose of a taxonomy is to lay the fundament for further research by systematically classifying characteristics of ICOs and thus, fostering the understanding of the phenomenon (Glass and Vessey, 1995). The focus on the process of classification allows for a systematic examination of the general principles and issues underlying the classification scheme. Equally important, taxonomies can help to predict future development areas, similar to the periodic table which predicted the existence of elements decades before they could be isolated (Glass and Vessey, 1995). A multitude of scientific studies have been successfully relying on the creation or use of taxonomies to lay the groundwork for emergent fields of research, when exploring a young field such as cloud computing (Keller and König, 2014), decentralized consensus systems (Glaser and Bezzenberger, 2015), smart things (Püschel et al., 2016), agile IT setups (Jöhnk et al., 2017) and blockchain-based systems (Xu et al., 2017). In line with these best practices we follow the iterative designoriented taxonomy development method proposed by Nickerson et al. (2013), which goes beyond the traditional approach as proposed by Bailey (1984). This method integrates conceptual and empirical perspectives into one comprehensive method and, thus, fosters the iterative usage of both paradigms (Nickerson et al., 2013). The taxonomy development method comprises the following seven steps: 1) determination of a meta-characteristic, 2) determination of ending conditions, 3) choice of approach (i.e., empirical-to-conceptual or conceptual-to-empirical), 4) conceptualization of characteristics and dimensions 5) examination of objects, 6) design (i.e., initial design or revision of the taxonomy) and 7) testing of the ending conditions. While the researcher chooses the meta-characteristic and ending conditions at the beginning of the development process, several iterations of taxonomy design and improvement follow (steps 3 to 6). It is important to note, that the researcher decides for an approach in every iteration (either empirical-to-conceptual or conceptual-to-empirical). The researcher tests the resulting taxonomy after each iteration against the ending conditions until they are finally met. Since taxonomies not only systematically describe current relationships, and dependencies of a specific field of research, but also allow to evaluate future developments. Thus, we use the final taxonomy to classify our ICO sample and apply a cluster analysis to identify predominant ICO pattern that represent valid starting points for future in-depth evaluations to better understand the evolution of ICOs.

4 Application of the Research Method

Following the approach of Nickerson et al. (2013), we define our meta-characteristic in step 1. Since the meta-characteristic is the most comprehensive characteristic, it is directly reflecting the purpose of the taxonomy. Further, it is important to define the purpose according to the target group of the taxonomy to enable understanding and appropriate use (Nickerson et al., 2013). As our study aims to serve as a basis for further research not only for the IS discipline but also for the Finance discipline, we define our meta-characteristic as follows: *Design parameters and characteristics of Initial Coin Offerings as a novel form of crowdfunding.*

In step 2, we define the ending conditions for evaluation of the resulting taxonomy after each development iteration. We apply both the subjective and objective ending conditions proposed by Nickerson et al. (2013). To fulfil the subjective ending conditions, the taxonomy should be *concise*, meaning it contains a limited number of dimensions as well as a limited number of characteristics in each dimension (Bailey, 1994). Yet, to be *robust*, it also should still contain just enough dimensions and characteristics to differentiate the object of interest (Nickerson et al., 2013). To be conceived as *comprehensive*, the taxonomy should be able to classify all known objects in the specific domain and include all dimensions of the objects of interest (Bailey, 1994). The option to *extend* the taxonomy when new types of objects appear through the inclusion of additional dimensions and new characteristics should be feasible. To be *explanatory*, it is important that the taxonomy is not merely descriptive, but enables the reader to identify the characteristics without full knowledge of the object's details (Nickerson et al., 2013). To meet the eight objective ending criteria, described in Table 1, which focuses on the formal correctness of the development process and the resulting taxonomy, we test and evaluate the taxonomy against the criteria after each iteration.

Subjective ending criteria	Objective ending criteria
Concise	All objects or a representative sample of objects have been examined.
Robust	No object was merged with a similar object or split into multiple objects in the last iteration.
Comprehensive	At least one object is classified under every characteristic of every dimension.
Extensible	No amendments to dimensions or characteristics were made in the last iteration.
Explanatory	No dimensions or characteristics were merged or split in the last iteration.
	Every dimension is unique and not repeated.
	Every characteristic is unique within its dimension.
	Each cell (combination of characteristics) is unique and is not repeated.

Table 1. Subjective and objective ending conditions (Nickerson et al., 2013)

Next, for the empirical perspective of our research we took a sample of 52 real-world cases of ICOs for the taxonomy development and to examine them thoroughly. We selected sample cases used for the taxonomy building process from databases operated by Coindesk and Smith and Crown, containing an overview of historic and ongoing ICOs (Coindesk, 2017; Smith and Crown, 2017). For the purpose of validity we took a sample of cases ranging from the first known ICOs in the year 2013 until the finalization of this study in late 2017. We obtained relevant information about each case from whitepapers and other documents accompanying the ICO such as legal term sheets, press releases and websites specifically set up for the purpose of informing the public about the ICO as no scientific database or comprehensive set of ICOs is publicly available yet. Where available, we also analyzed the smart contracts code used for the ICOs to obtain in-depth knowledge. While we primarily relied on qualitative data, we also utilized quantitative data such as e.g. the number of tokens reserved for the team to calculate the relative share. The gathered information on real-world ICOs was used as basis for the identification of relevant ICO traits as well as for the evaluation theory-driven dimensions and characteristics. Subsequently, we performed step 3-7 in an iterative manner. In line with Nickerson et al. (2013), we reciprocally conducted conceptual-to-empirical and empirical-to-conceptual iterations. In empirical-to-conceptual iterations, we used a subset of our sample cases and conducted detailed examinations to derive characteristics. By doing so, we clustered similar ICOs together and grouped the characteristics into dimensions. Additionally, we analysed literature related to the identified dimensions and characteristics to strengthen and verify the findings. Subsequently, we tested the developed taxonomy against the ending criteria. Whenever the taxonomy failed to meet the specified ending conditions, we performed another iteration. In conceptual-to-empirical iterations we utilized literature on forms of auction theory, IPO processes and crowdfunding to identify literature-based characteristics and dimensions. Subsequently, we applied a subset of our sample cases to verify the applicability of these characteristics and dimensions. However, since ICOs are novel and fundamentally different to traditional approaches this approach proved of limited use. Thus, we made use of additional primary data in form of expert interviews. To achieve this, we chose a semi-structured interview approach with designed questions and interview guidelines to assure comparability and to preserve the explorative nature (Yin, 2013). We framed our interviews around a green field approach to gather the unbiased knowledge and ideas towards ICO characteristics (conceptual-to-empirical). In addition, we discussed our current taxonomy with subject matter experts, which allowed us to evaluate the proposed taxonomy based on real-world experience (empirical-to-conceptual) (Schultze and Avital, 2011).

Id	Current position	Relevant experience
1	Board member, Bitcoin Austria	ICO investor
2	Academic Researcher, University of Liechtenstein	ICO advisor, ICO researcher
3	Consultant, icon associates	ICO advisor
4	Partner, Stadler Völkel Attorneys at Law	ICO advisor
5	Academic Researcher, Technical University Munich (TUM)	ICO researcher
6	Academic Researcher, University of Warwick	ICO researcher
7	Board Member, Hydrominer	ICO issuer

Table 2. Overview of expert interviews

In total, we conducted seven semi-structured expert interviews, which lasted between 30 and 45 minutes, via phone, recorded them and analyzed them according to scientific standards afterwards (Dexter, 2006). As illustrated in Table 2, we selected experts having relevant professional experience as either ICO issuer, ICO investor, ICO advisor or ICO researcher. We selected all experts based on the criteria that they possessed either relevant practical knowledge or have made significant scientific contributions in the field of ICOs. Every single expert interview was incorporated in the taxonomy development process as a development iteration. For each interview, we analysed the expert feedback and incorporated significant changes in our taxonomy. For instance: While we found only minor discrepancies, for the dimension *Token purpose/type*, where several experts preferred the legal definitions of *utility tokens* and *securities*. However, we decided not to follow these suggestions as the general legal framework of ICOs is yet unclear and differs from jurisdiction to jurisdiction. After this step, after each interview, we verified the amended taxonomy through our real-world cases and improved the taxonomy if necessary. Finally, after 14 iterations in total, the specified ending conditions were met, and the interviewed experts confirmed the taxonomy as complete, comprehensive and explanatory.

5 Taxonomy for a Blockchain-enabled form of Crowdfunding

We present our final taxonomy in Table 3 and describe the dimensions and characteristics in detail in this section. The final taxonomy consists of 23 relevant dimensions encompassing 62 characteristics that were defined according to the specified meta-characteristic to describe the design parameters of ICOs. The dimensions were ordered and grouped into three thematic categories – token, issuer and sales terms – to increase the readability of our artefact in coordination with the experts interviewed. The numbers included in brackets refer to the absolute frequency of each characteristic in the analyzed sample. The sample classification was conducted in multiple rounds by two authors in an independent manner followed by discussion sessions.

	Dimension	Characteristics			
Token	Token implementation level	native (9)	on-chain (42)	sidechain (1)	
	Token purpose/type	usage token (31)	work token (3)	funding token (9)	staking token
	Token supply growth	fixed supply (38)	fixed inflation rate (5)	adaptive inflation rate	
	Token supply cap	uncapped (11)	capped (41)		
	Token burning	no (42)	yes (10)		
	Token distribution deferral	no (22)	yes (30)		
	Token holder voting rights	no (38)	yes (14)		
Issuer	Issuing legal structure	limited liability (42)	foundation (10)		
	Team token share	minority stake (45)	half (3)	majority stake (4)	
	Team vesting period	none (16)	single period (15)	multiple periods (21)	
Sales Terms	Pre-sale before ICO	none (26)	private pre-sale (21)	public pre-sale (5)	
	Pre-sale discount	no (27)	yes (25)		
	Planned occurrence	single round (38)	multiple rounds (12)	not specified (2)	
	Registration needed	no (23)	yes (29)		
	Eligibility restriction	none (28)	geographic (17)	accreditation (3)	multiple (4)
	Purchase amount limit	none (43)	minimum (6)	maximum (2)	both (1)
	Auction mechanism	none (49)	Dutch auction (3)		
	Sales price	fixed (42)	floating (10)		
	Price fixing currency	fiat currency (17)	crypto currency (35)		
	Funding currency	crypto currency (43)	crypto and fiat currency (9)		
	Funding cap	uncapped (9)	soft cap (2)	hard cap (27)	multiple (14)
	Time horizon	fixed ending date (41)	fixed ending block time (10)	open-end (1)	
	Time-based discount	none (26)	single rate (5)	multiple rates (21)	

Table 3. Final taxonomy of ICOs

5.1 Token

The basis of any ICO is a token that is sold during the ICO process. However, we found multiple technical, monetary and legal aspects where the tokens fundamentally differ and thus influence the characteristics of the ICO itself.

Token implementation level: Regarding the token implementation level we found fundamental differences between ICOs. Consistent with literature, a token can either be *native*, meaning it is inherent to a blockchain or *on-chain*, which means it is created as an app coin using smart contracts on top of an existing blockchain like Ethereum (Buterin, 2014). In one case, the token was existing on a so-called *sidechain*, which can be interpreted as a solution in-between a blockchain and a smart contract.

Token type/purpose: Another differentiation of tokens offered in an ICO is the token's purpose. Tokens can be categorized in *usage tokens*, which give the holder access to a digital service but generally does not include rights to contribute or earn rewards, *work tokens*, which enable holders to contribute work to a network such as a decentralized organization (Tomaino, 2017), *funding tokens*, which according to one expert interviewed have no other use than to raise funds and *staking tokens*, which refers to the potential use of tokens as right to be a stakeholder, participate in a network's decisions and in some cases earn a reward (Buterin, 2017b; Muehlemann, 2017).

Token supply growth: The underlying tokens differ in terms of general token supply growth. We found most of the analyzed cases to have a *fixed supply*, meaning no further tokens are issued in the future through mining or otherwise (Conley, 2017). Experts pointed out in the interview process that in some cases, a *fixed inflation rate* or an *adjustable inflation rate* exist and referred to an adjustable increase of the token supply as voted for by stakeholders as example.

Token supply cap: The supply of tokens (number of tokens) available to buyers in an ICO can be restricted, which is typically referred to as *capped* in sales prospects and whitepapers. Unrestricted token supply during the ICO process is consequently referred to as *uncapped* (Buterin, 2017a).

Token burning: As in some cases it was explicitly stated that unsold tokens are being destructed, which is also referred to as *token burning*, we included the dimension with the characteristics *no* and *yes* in our taxonomy (Buterin, 2017b).

Token distribution deferral: Our taxonomy research process revealed that most tokens are not distributed to buyers outright after completion of the ICO. Instead the distribution is facilitated after a specified deferral period. These findings were confirmed when conducting expert interviews, thus we integrated this dimension with the characteristics *no* and *yes* in our taxonomy.

Token holder voting rights: It was pointed out by several experts that while for most tokens, the holders do not possess any voting rights, some tokens do enable holders to vote on certain proposals. Thus, we include the dimension with the characteristics *no* and *yes* in our taxonomy.

5.2 Issuer

Behind every ICO we examined, we found a team of people or an organisation using a legal structure to facilitate the process, while keeping a certain percentage of the tokens for themselves, sometimes with self-imposed restrictions.

Issuing legal structure: In expert interviews, it was mentioned multiple times that the issuing legal structure is another important dimension which should be included in the taxonomy. In line with our aim to provide practitioners with valuable insights common organizational structures are of vital importance. Thus, we decided to include the dimension *issuing legal structure*. Analysing further cases, we found *limited liability* and *foundation* to be used, which was confirmed by a legally skilled interview partner afterwards.

Team token share: The examination of sample cases revealed that the team responsible for issuing tokens during an ICO typically keeps a sizable portion of tokens for themselves. We distinguish ICOs where the team owns a *minority stake*, *half* or a *majority stake* of the tokens at completion of an ICO.

Team vesting period: Consequently, the ability of the team or company behind an ICO has the power to influence the market price of tokens by selling their stake (Buterin, 2017a). To avoid opportunistic profit taking and to protect investors, we found some ICOs to contain a clause specifying that the tokens of team members or the company are locked-up for a certain period. Some cases even contain a more sophisticated approach of multiple periods, bound to certain success criteria. As lock-up periods are also common in IPOs and Venture Capital, where they are referred to as *vesting period*, we include the characteristics *single period* and *multiple periods* beside *none* in our taxonomy (Ehrsam, 2017).

5.3 Sales Terms

We found multiple design parameters of ICOs regarding the sales process that add further complexity, which we included in a separate category. Typically, these parameters are included in the sales terms of an ICO.

Pre-Sale before ICO: While examining ICO cases, it is notable that some ICOs are preceded by a pre-sale that is declared as part of the overall ICO process. We found these to be either limited to advisors, community members or accredited investors or open to the public. Thus, we include this dimension with the characteristics *private pre-sale*, *public pre-sale* and no presale in our taxonomy. The usefulness of the dimension was confirmed when interviewing experts.

Pre-Sale discount: Following up on the identified dimension of pre-sales preceding ICOs, we found that in some cases tokens were offered at a discount to buyers. Thus, we included the finding in our taxonomy (*yes* / *no*).

Planned occurrence: The analysis of cases revealed that while most ICOs are one-time events, in some cases the party issuing tokens is actively planning multiple investing rounds. In some instances, the issuing party deliberately left open the technical possibility of a second ICO, while communicating it as a mere possibility. Thus, we include the characteristics *single round*, *multiple rounds* as well as *not specified* in our taxonomy.

Registration needed: Recent attention of regulators as discussed above seems to impact the need of registration before the purchase of tokens at an ICO. We found many recent cases to require up-front registration of prospective buyers. In contrast, the older cases we researched typically did not require investors to register. These findings were also confirmed by the experts we interviewed. Thus, we include the dimension with the characteristics *no* and *yes* in our taxonomy.

Eligibility restriction: With required registration, the possibility of restricting investors is introduced. While in some cases we found no eligibility restrictions, in others *geographic* restrictions applied, or access was only permitted to investors with *accreditation* as defined by national regulations. In a few cases we also found *multiple* restrictions. Interestingly, we found these restrictions to resemble the regulations for traditionally crowdfunding (Sixt, 2014).

Purchase amount limit: During analysis of cases we found differences for allowed purchase amounts. While most cases had no specified purchase amount limits (*none*), in some cases we found a *minimum* or a *maximum* purchase amount limit or in a few cases *both* limits were in place.

Auction mechanism: The analysis of ICO cases revealed that a few cases of token sales were conducted using auction mechanisms such as various forms of a so called *Dutch auction*. In a Dutch auction, an auctioneer first announces a very high price and gradually lowers it until it is accepted by one of the bidders (Hausch et al., 1992). More specifically, we found second-price Dutch auctions, as well as inverse Dutch auctions to be used in ICOs, which we subsumed under the characteristic. While both auction theory literature and expert interviews pointed us to additional forms of auctions that could be used in theory (e.g. Vickrey auctions), no case was found where other forms of auctions have been tried in ICOs so far (Teutsch and Buterin, 2017).

Sales price: Research of cases revealed that ICOs differ at the sales prices, which can either be *fixed* or *floating*, meaning it fluctuates and is influenced by factors such as demand. Experts pointed out that this dimension can best be understood in combination with the auction mechanism used.

Price fixing currency: As we found token sales prices to be fixed for some cases, a deeper look into the currency the token is fixed in revealed that prices can either be fixed in *cryptocurrency*, such as Bitcoin or Ether, or in *fiat currency*. The latter is a term for currency established by governments to centre an economy onto one kind of transaction medium (e.g. Euro or US-Dollar) (ECB, 2015).

Funding currency: Analogous to the options for fixing a price, the funding currency that can be used to purchase tokens in an ICO can be either *cryptocurrency*, or in a few cases both, *fiat currency and cryptocurrency*, as our research showed.

Funding cap: We identified the existence of funding caps in some cases, whereby a distinction between *hard capped* and *soft capped* limits has to be made. The former term relates to a restriction that ends an ICO immediately, as soon as a certain amount of funding has been reached. The latter term relates to a minimum amount of funding that must be reached to trigger a time limit of the remaining ICO period (Luxembourg House of Financial Technology and Stellar Development Foundation, 2017). ICOs that do not have one or even *multiple* funding caps, are typically referred to as *uncapped*. Literature analysis of crowdfunding revealed that increasing funding goal size is negatively associated with success within a reward- and donation-based crowdfunding setting (Mollick, 2014). Further research could address this question for ICOs as well.

Time horizon: While in most cases a *fixed ending date* is specified as ending condition of the ICO, in a few cases we found *fixed ending block time* to be used. Block time relates to the occurrence of a specific block of a blockchain being mined, which usually can be predicted with limited accuracy (Swan, 2016). In some cases, the time horizon for an ICO was being kept *open* and no ending criteria based on time was specified at all. Related research of equity-based crowdfunding found that increased duration of funding a project decreases the chance of success (Danmayr, 2014). Further research might show, if similar implication for ICOs can be observed.

Time based discount: When analysing ICOs we found time-based discounts a common sales term. While in some cases the discount consisted of a *single rate*, in a few cases a more sophisticated system of *multiple discount rates* was utilized. These findings were confirmed by experts as well.

5.4 Application of the proposed Taxonomy

Developing the proposed taxonomy, we dissected and systematically classified 52 real-world ICOs. Overall, in the majority of ICO cases (81%) the tokens are instantiated as on-chain tokens, classified as usage tokens (60%) and distributed with a deferral (58%). Additionally, in most cases the token supply is fixed with no growth (73%) and the token supply is capped (79%). Burning of tokens is merely applied in a minority of the cases (19%), and so is the transfer of voting rights to investors (27%). Most token issuers rely on the legal structure limited liability (81%) and keep a minority of tokens within the team or organisation (87%). However, there are also cases where they keep the majority (8%) or half (6%) of tokens internally. In addition, most issuers establish some form of vesting period (69%) within which team members are not able to sell their tokens. Regarding pre-sales our dataset is equally balanced between cases with and without pre-sales. In ICOs with a pre-sale, they are in 96% of the cases associated with a discount compared to the regular sales period. Most issuers conduct the token sale as a single round occurrence (73%), which requires a registration prior to investments (56%). Further, in the majority of cases no eligibility restriction (54%) and no auction mechanism (94%) is applied. It is apparent, that in most ICOs the sales price is fixed (81%) and bound to a cryptocurrency (67%). Investments can be made in crypto currency (83%) without an investment limit per participant (83%). The number of tokens distributed is in most cases limited in some way (83%) and the sales period has a fixed ending date or block time (98%). Further, in every second ICO time-based discounts are applied.

To better understand the ICO phenomenon and to illustrate the usefulness of our taxonomy we conducted a cluster analysis to identify ICO archetypes. For clarity and comprehensibility, we restrict the number of clusters to four. We utilize the simple-K-means algorithm (distance function: Euclidean distance) in our analysis (Arthur and Vassilvitskii, 2007). We summarize the results of the cluster analysis and highlight prevailing characteristics of each cluster in Table 4. Hereinafter, we describe the four ICO archetypes of our dataset, which indicate how common ICOs are designed and thus might serves as best practices.

Cluster 1 - Geographically restricted ICOs with hard funding caps and private pre-sales: This archetype represents the largest group of ICOs and reveals particularly interesting characteristics in the dimensions *pre-sale before ICO*, *pre-sale discount*, *eligibility restriction* and *funding cap*. ICOs within this cluster offer a private pre-sale with discount, are geographically restricted and reveal a hard funding cap.

Cluster 2 - Geographically restricted ICOs with fiat money-oriented pricings and staking tokens: In this cluster the dimensions *token purpose/type, token holder voting rights* and *price fixing currency* are striking. This archetype uses staking tokens and transfers voting rights to investors. Further, ICOs are geographically restricted and token prices are fixed in a fiat currency.

Cluster 3 - Uncapped global foundation ICOs with native blockchain tokens: ICOs classified into cluster 3 are especially characterized by their manifestations in the dimensions *token implementation level*, *token supply growth* and *cap* as well as *issuing legal structure* and *planned occurrence*. This archetype builds upon native tokens, reveals an uncapped token supply and a fixed inflation rate regarding to the token supply growth. Further, it is the only archetype that covers multiple investment rounds.

Cluster 4 - Global ICOs with hard funding caps: This archetype does not reveal unique characteristics but rather represents combinations of distinctive traits of the other three clusters. This archetype uses on-chain tokens, allows for global investments and exposes a hard funding cap.

	Cluster 1 (40%)	Cluster 2 (13%)	Cluster 3 (13%)	Cluster 4 (33%)
Token implementation level	on-chain	on-chain	native	on-chain
Token purpose/type	usage token	staking token	usage token	usage token
Token supply growth	fixed supply	fixed supply	fixed inflation	fixed supply
Token supply cap	capped	capped	uncapped	capped
Token burning	no	no	no	no
Token distribution deferral	yes	yes	yes	yes
Token holder voting rights	no	yes	no	no
Issuing legal structure	Limited	Limited	Foundation	Limited
Team token share	minority stake	minority stake	minority stake	minority stake
Team vesting period	multiple periods	multiple periods	no	no
Pre-sale before ICO	private presale	no	no	no
Pre-sale discount	yes	no	no	no
Planned occurrence	single round	single round	multiple round	single round
Registration needed	yes	yes	no	no
Eligibility restriction	geographic	geographic	none	none
Purchase amount limit	none	none	none	none
Auction mechanism	none	none	none	none
Sales price	fixed	fixed	fixed	fixed
Price fixing currency	cryptocurrency	fiat currency	cryptocurrency	cryptocurrency
Funding currency	cryptocurrency	cryptocurrency	cryptocurrency	cryptocurrency
Funding cap	hard cap	multiple	uncapped	hard cap
Time horizon	fixed ending date	fixed ending date	fixed ending date	fixed ending date
Time-based discount	none	multiple rates	multiple rates	none

Table 4. Results of the cluster analysis

6 Conclusion and Outlook

We investigated the implications of blockchain technology with a specific focus on ICOs as a novel approach to crowdfunding. Since ICOs have emerged as a new phenomenon, IS researchers, investors, practitioners and financial regulators alike struggle to fully understand the different forms and associated consequences. This is also caused by the complex and heterogenous characteristics of ICOs that allow for various instantiations. Further, scientific literature on ICO characteristics and underlying technologies is missing. To bridge this research gap, we focused our research on the identification and evaluation of ICO design parameters. To achieve this, we followed the taxonomy development method of Nickerson et al. (2013) and propose a taxonomy for ICOs. In the development, we primarily built on empirical data from both real-world ICO cases and expert knowledge from semi-structured interviews with practitioners involved in ICOs. We collected data of 52 ICOs and conducted seven semi-structured interviews with ICO experts. Our proposed taxonomy consists of three categories with a total of 23 dimensions and allows researchers and practitioners (e.g. ICO investors) to better understand ICOs and associated consequences.

Before stating our recommendations and emphasizing our contribution to both research and practice, we acknowledge some limitations that open promising avenues for further research. First, although we used Coindesk and Smith and Crown as established basis for our real-world ICO cases, the dimensions and characteristics are influenced by the applied data sample and the sequence of iterations in the development process, which depicts a generally valid drawback. By applying a divergent sequence of iterations and additional cases, further research may further evaluate proposed taxonomy. Second, globally, 222 ICOs (as of November 15th, 2017) have taken place, we utilized an appropriate dataset, however we might have missed some instantiations that rapidly evolve in the ICO market (Coindesk, 2017). Further research might function as an update of our taxonomy and include ICO cases that occurred after November 15th. Third, in our research, we did not have a specific focus on dependencies between dimensions and characteristics as well as success criteria of ICOs. Thus, future research might use our taxonomy as a promising starting point to explore potential dependencies. In addition, the success of ICOs both in the eyes of issuers and investors is subject to promising research. The parameters listed in our taxonomy can serve as a starting point for analysis of success factors that might explain not only ICO events itself, but could also shed light on token performance on secondary markets. Fourth, the generalizability of our ICO archetypes needs to be verified through further research. However, our cluster analysis and the identified ICO archetypes might serve as a profound basis for in-depth case study research to better understand the ICO processes. It also remains for future research to examine how ICOs further develop and how the fast developments of blockchain technology influence ICOs.

The theoretical contribution of our research addresses the aforementioned research gap in three ways. First, to the best of our knowledge our taxonomy is the first scientific artefact that contributes to the descriptive knowledge of the young research domain of ICOs. While existing research focuses on important areas like how to conduct ICOs and launch ICO platforms (Li and Mann, 2018), our research represents a first step to address the call for in-depth analyses on ICOs (Clayton, 2017). By developing our descriptive taxonomy, we conducted an important step towards the development of a higher-order theory (e.g., predictive theory, theory for design and action) (Gregor, 2006). Second, we lay the foundation for further research in the area of ICOs, and their establishment as a form of crowdfunding. We achieved this objective by addressing specific characteristics of ICOs to improve the understanding, providing a scientifically selected set of ICO cases and by highlighting promising avenues for future research. Third, our cluster analysis that identified ICO archetypes represent a first step towards the identification of predominant ICO types, which might evolve into established forms of crowdfunding.

Besides its theoretical contribution, our paper provides practitioners with valuable insights. First, we offer insights into ICOs and delineate the essential design options that can help individuals or organisations that analyse, advice or consider launching an ICO. Second, as there is no one-size-fits-all model of ICOs, our taxonomy can aid the decision-making process of choosing the specific parameters of an ICO. Third, the proposed ICO clusters indicate how common ICOs are designed and thus might serves as best practices for practitioners. Fourth, our work suggests that ICOs are a valid alternative to crowdfunding that has to be considered and understood when making strategic decisions such as raising capital for a project.

Acknowledgement:
This research was (in part) carried out in the context of the Project Group Business and Information Systems Engineering of the Fraunhofer Institute for Applied Information Technology FIT.

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