To Token or not to Token: Tools for Understanding Blockchain Tokens

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Completed Research Paper

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Abstract

The growing usage of tokens in real-world blockchain projects – mostly visible in ICOs – has unveiled the need to understand what blockchain tokens in fact represent and how they relate to their underlying business model. Previous research has contributed to this gap but often lacks a comprehensive understanding of tokens and their design as well as of the growing and rapidly-changing complexity in token landscape. This has crucial implications for assessing tokens' value and utility. Applying a structured, scientific approach towards blockchain tokens, we provide a comprehensive token classification and a decision-aid on token design. This is based on a literature review and an empirical study to cover this research gap. Our work offers a novel contribution in an emerging field within the Blockchain research domain and proposes structured analytical tools which can be used by both practitioners and researchers.

Keywords: blockchain, token, tokenomics, token design, cryptoeconomics, cryptocurrency

Introduction

The emergence of a new wave of blockchain-based projects has arrived hand in hand with a growing token usage (Diedrich 2016) and the new field of *Tokenomics* (Mougayar 2017). This requires further insights into unveiling what blockchain tokens in fact represent and how they connect to their underlying business model. In general, a token is a well-known concept which roughly stands for a representation of something unique (Lewis 2015). This uniqueness can exist in different shapes and forms. For many years, tokens - or comparable concepts - have been present and imagined in a plethora of schemes, from many firm's loyalty programs, to casino chips or even in claims to beers in music festivals, IT security access permissions or laundry credits (Sehra et al. 2017). In the Blockchain world, tokens have emerged as the artefact of choice to represent assets, utility or a claim on something inherent to a specific blockchain project (Pilkington 2015). Thus, tokens exist due to their usefulness of representing something digitally. This goes hand in hand with the need to represent scarcity of digital goods in the blockchain (Miscione et al. 2018). Tokens' divisibility, ease-of-use and tradability have turned them into ideal value containers which can be as easily tradable as executing a transfer of its ownership to another agent who now holds that same claim (Pilkington 2015). Previous research has contributed to a greater understanding on token design by categorising tokens and distinguishing them along a few dimensions which roughly represent token attributes (Euler 2017). However, blockchain tokens have in the recent past increased not just in number but also in complexity (Euler 2017). Besides novel functions many tokens also apply several of them simultaneously (Mougayar 2017) whilst others may not even be advisable in the first place (Lewis 2015). These are generally perceived as signs of a yet young technology facing rapid changes both from a technical and a business standpoint (Diedrich 2016). In this sense, existing tools in IS research have fallen short of achieving a comprehensive token taxonomy which is both representative and accurate of the current token landscape.

On the other hand, the early development stage of blockchain tokens indicates that many practitioners and decision-makers still perceive the need for decision-aid tools on whether a token makes sense in a blockchain application in the first place and which can guide them into making an informed decision on token design. This assumes particular relevance in the face of greater scrutiny in evaluating tokens' utility and valuation, something which has been affecting both the development of blockchain business models and token investors alike (Warren 2017). Decision-aid tools based on token classification and application purpose have the potential to allow a more accurate distinction between valuable and non-valuable tokens, and enable a better assessment of token investment as a whole (Yadav 2017). To the best of our knowledge, such comprehensive frameworks addressing the current blockchain landscape and stemming from an IS Research standpoint are still lacking. Therefore, we propose to answer the following research questions:

RQ1: What kind of tokens are used in Blockchain applications and how are they distinguishable?

RQ2: How can we better inform and structure decision making on token usage in a Blockchain application?

In this work we ask: to Token or not to Token. Departing from an existing blockchain project called Car Dossier, where there is a lack of decision-aids to support the introduction of a native token, we report on both a literature review and an empirical study on token classification and design. We begin by collecting and systematising theoretical contributions towards token classifications and bringing them together in a single morphological box. We then interview 16 blockchain applications with 18 different tokens along distinct maturity levels and token design, and test them against our morphological box. We successfully identify patterns from which several token archetypes can be derived to assist both token classification and decision-making. We further complement our solution with a decision tree model based on our research. Finally, we apply our solution to the Car Dossier and demonstrate its applicability in practice.

Methodology

Design Research

This study follows a Design Science Research approach, which provides guidance in developing new knowledge about IT artefacts and their use in practice (Gregor and Hevner 2013; Hevner 2007; Nunamaker et al. 2015). We follow the DSR paradigm to first develop a classification of tokens and subsequently create a tool which helps in better informed and structured decision making on using tokens in blockchain applications. To create generalisable knowledge, we go through a process proposed in the Design Theorising Framework (Lee et al. 2011), which suggests operating in two domains: an abstract and an instance domain. Hence, we depart from an instance problem – the Car Dossier blockchain application – which emerges from a running blockchain project where the stakeholders must take a decision on whether they need a token and, if so, how this should be designed. The project is described in more detail later in the Evaluation subsection of this paper. We follow this by diving into the underlying abstract problem. Here we base our research on both literature review and empirical data in order to develop two analytical tools (a morphological box and a decision tree) which respectively address our RQ1 and RQ2, and thus address the problem at hand. These are then evaluated back in the initial instance problem (Car Dossier). The abstract domain includes generalised knowledge about explored class of problems and class of solutions, while the instance domain describes a specific problem and its specific solution, which can be observed in the real-world cases. The framework results in a four-quadrant overview. Figure 1 illustrates the framework, which guided us in going from instance to abstract domain, and ultimately back to instance.

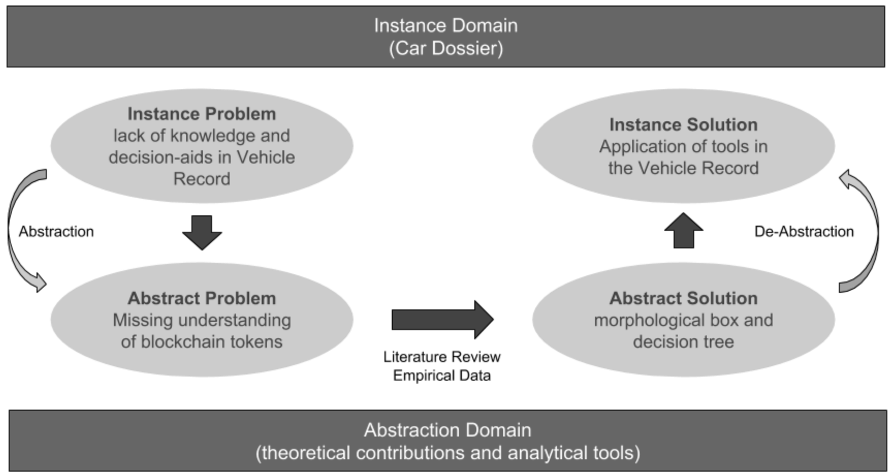

Figure 1. Problem and Instance Domain

Following this iterative approach, which is typical for DSR studies (Hevner 2007), we are then able to switch between abstraction and non-abstraction in a structured flow which also ensures the constant validation of our analytical tools through their direct application on the Car Dossier application.

Data Collection

In the course of 30 days we collected a list of blockchain applications from three main sources:

- Literature used on our research, including backward and forward search (Brocke et al. 2009)
- News articles on platforms[1] widely used by the blockchain community and practitioners
- Twitter platform where we followed blockchain applications mentioned in our literature, and whose recommendation algorithm suggests related blockchain projects whenever other twitter channels from other projects are followed, thereby allowing the expansion of our list with new projects
- White Papers from the projects in our shortlist

When collecting our list, we placed more focus on mature projects as well as those on which there had been previous (or were being conducted) token sales. We also ensured the inclusion of projects in different application domains to provide a broader study. On the other hand, cases which lie outside of the scope of our research, such as major cryptocurrencies like Bitcoin, were excluded.

In the end our list encompassed 113 projects. From these, we proceeded to contact each individually by requesting a 30-min time block for a semi-structured interview on the topic of blockchain tokens with a reference to their project. With this approach, we could arrange 13 interviews during our first round (January – March, 2018) and 3 additional during a second round (August 2018). The second interview round followed the same approach as the first and aimed to enhance our data basis and check if we had reached saturation. Five interview requests were rejected, and the remaining projects did not respond. All responses except one occurred within 15 days of the initial contact request. Due to two of the 16 projects exhibiting dual token systems, we were able to collect data on 18 different tokens. The 16 interviews were all conducted remotely, assisted by recording devices, and conducted as semi-structured interviews (Myers & Newman 2006). An interview script was designed prior to the date of the first interview and was consistently used throughout the data collection process. Although the questions were partially dependent on the application's business model and its token, a common main focus was placed on the following topics:

[1] https://www.coindesk.com/, https://coincenter.org/, https://cointelegraph.com/

token role; token utility; token supply; the ways in which the token can be acquired; indispensability of the token with regards to the business model. All participants were informed of the interview script at least two days ahead of the interview and were thus given some degree of freedom to alternate between questions and introduce new topics to the discussion which could be of relevance to the topic. The interviews were later transcribed and analysed in detail as basis for building the proposed framework. For this step, an open coding process was used (Saldana 2015). For each topic discussed, we assigned codes which addressed the token at-hand within the categories elicited in our literature review. In those cases which could not be categorised within those boundaries, we used additional codes which then were used to extend our solution.

Analytical Tools

Our results take the form of two analytical tools. For our RQ1, we developed a morphological box. This concept is used as a problem-solving technique for multi-dimensional questions (Zwicky 1969). A grid resembling a table contains on the first column the different parameters which characterise any instantiation of what we are trying to model. The interplay of different combination of attributes along the different parameters provides a multi-dimensional description of the element, thereby allowing the identification of patterns. In our research, these patterns take the form of token archetypes. The creation of token archetypes was the result of an iterative process. Tokens from the empirical data were grouped on the similarity of their box attributes to build an archetype, remaining tokens were their own archetype. In order to enrich the insights from the morphological box and assist decision-making along RQ2, we developed a decision tree which questions the use of a token in a blockchain application and guides practitioners and decision-makers towards building a token design which obeys the underlying business model.

Related Work

Cryptographic Tokens

As mentioned in the Introduction Section, currently tokens are a well-known concept that is used to represent something unique (Lewis 2015). One of the most complex challenges is to gain full understanding of them (Evans 2014). This question is not easily answerable. The first wave of blockchain projects have mostly been pioneering testing grounds for a new technology which now is widely seen by many as a disruptive force for cross-domain innovation (Dietrich 2016). With the emergence of blockchain-based projects for every [un]imaginable domain and a growing ambitious vision on what the technology can truly achieve, there has been a corresponding increase in the complexity of token design (Lewis 2015). Adding to this the constant resort to ICOs and Token Sales as funding schemes for many of these projects, and evidence has risen on the widening scope of misunderstandings and the lack of information surrounding tokens and the true value of the claim they represent (Conley 2017). These are symptoms perceived by many as growth pains in a technology still constantly facing new challenges. A breakdown of this issue differentiates two different questions.

The Case for Using Tokens

The first question is whether a token is necessary for every blockchain project in the first place. The arguments for issuing tokens are various. In this line of thinking, the purpose of issuing tokens tends to be justified by its role in the following dimensions:

- **currency**: by acting as transmission of value (Pilkington 2015; Evans 2014), unit of account (Conley 2017) and store of wealth (Wenger 2016; Ehrsam 2016; Tomaino 2017c)
- **validation incentive**: by ensuring distribution consensus and data consistency (Pilkington 2015; Evans 2014; Catalini et al. 2016; BlockchainHub 2017)
- **usage incentive**: by allowing access or promoting platform usage (Chen 2017; Wenger 2016; Lena & Oksana 2017; Ehrsam 2016; Tomaino 2017c)
- **tool for accelerating network effects**: by incentivising early adoption (Chen 2017; Sehra et al. 2017; Wenger 2016; de la Rouviere et al. 2015; Voughan 2017; Ehrsam 2016)

- **tool for governance**: by preventing spamming or providing rights to participate in the platform's development (Conley 2017; Sehra et al. 2017)
- **representation of asset ownership**: by encapsulating asset-backed or asset-based property rights (Chen 2017; Sehra et al. 2017; de la Rouviere et al. 2015)
- **profit-sharing**: by conferring its owner the claim to dividends or equivalents (Conley 2017; Sehra et al. 2017)
- **funding instrument**: by using the proceeds of a token sale to fund the development team or the community (Chen 2017; Voughan 2017)

All these dimensions - except perhaps for the funding one - address the need to tie an adequate value container to the network's growth and, sometimes, to its internal incentive system. Without this value container, goes this logic, and the business model would likely either not function as intended or not even work at all. Adding to this is the need for financing projects which would otherwise need to endure the frictious, slow and often tedious task of investor-shopping, or alternatively bootstrap their way up (Yadav 2017). In this sense, a Token Sale arises as a win-win solution which helps lift projects from the ground up faster and even with higher financing rounds (Massey et al. 2016). It is still often the case, however, that a blockchain project launches a Token Sale without even properly addressing the utility of the underlying token (Sehra et al. 2017; Tomaino 2017c). The presence of fraud in this domain is no stranger to this issue (Decentralpost 2018; Zetzsche et al. 2018).

Such has been the amount of arguments for using blockchain tokens that it is often not argued whether there might be cases where they are neither useful nor advisable. Here the arguments tend to be scarcer. While blockchain fierce critics tend to minimise the utility of any blockchain-related topic, within the blockchain-sphere tokens are still seen by many as an exclusive tool of permissionless blockchains, where the lack of trust among unknown participants lays ground for an internal incentive scheme which nudges them towards the platform's distributed consensus (Lewis 2015; Warren 2017). With respect to that, any permissioned blockchain lacks the need of issuing tokens outside of mere choice or pure funding aspirations (BlockchainHub 2017; Lewis 2015). This raises interesting questions on whether a token's purpose should in fact be analysed based on its underlying use cases, rather than on general judgements. Theories which justify tokens based exclusively on their specific token model are thus gaining ground (Ehrsam 2017).

Other authors stress the need to carefully evaluating cases where there might be conflict of interest between token holders. Indeed, this is a fact which can apply to any blockchain project which has conducted an ICO, where the token is both seen as a utility asset (user point of view) and an investment asset (investor point of view). It can be argued that this could represent a challenge for the growth of the network, since the latter wants the token price to rise whereas the former prefers it to remain stable. Some authors suggest that this apparent conflict of interest might be a prompt to disentangle the investment function of the tokens from their usage function (Rudolf 2017), a fact which could even lead to a dual token system.

Classifying Tokens

The second question is - provided the first one is answered positively - how to design and manage an appropriate token system which matches both the project's strategic and business model aspirations. This step extends the task of perceiving the purpose of a specific token. Many classifications have been proposed on how to differentiate tokens based on a specific property. While some of them are more widely used than others, there is still a lack of agreement on whether and how these can be arranged. One such example is the general distinction between cryptocurrencies and tokens. Although both domain literature (Catalini et al. 2016; Chen 2017; BlockchainHub 2017) and online market trackers [2] usually tend to agree on the distinction between coins or cryptocurrencies - which are native to a blockchain - and blockchain tokens - which are created on top of a blockchain, depend on it and governed by smart contracts -, this differentiation is based on the technical layer in which the asset is built on, and does not pertain to the role which the asset takes. Other authors interpret the difference between both cryptocurrencies and tokens by differentiating, respectively, between those which have the ambition to become *de facto* digital currencies and those whose

[2] http://coinmarketcap.com/

purpose is tied to its platform's business model and long-term value (Pilkington 2015; Evans 2014; Conley 2017). Following this differentiation approach, a third classification usually arises in the form of equity tokens, or tokenised securities (Benoliel 2017; Tomaino 2017b). In this sense, the distinction is not (solely) based on the technical layer anymore, but rather on the purpose of the asset, or the function it takes form of in the eyes of its holder. Needless to say, this discussion does not become clearer with the existence of different interpretations of the concepts token, coin, (crypto-)currency and money (Pilkington 2015; Evans 2014; Conley 2017; Chen 2017; Little 2017). An additional popular token classification is based on its functional ability. In this realm, usage tokens are contrasted to work tokens, and sometimes even accompanied by hybrid tokens which represent a mixture of both (Tomaino 2017a; Little 2017; Tomaino 2017b). Thus, tokens can exist as an access card which grants platform usage to its holder, as an incentive which is given out based on user behaviour, or as a compound of both. The literature further provides additional token classification based on the underlying incentive system (Lena and Oxana 2017), the type of chain it is based on (Srinivasan 2017), or its asset representation (Glatz 2016).

As mentioned in the Introduction, we perceive that the challenge in classifying tokens lies in achieving a comprehensive systematisation of all these attributes into a single morphological box which encompasses the ways in which every other token can be shaped. A first approach was proposed with the decomposition of token utility into three main dimensions: role, features and purpose (Mougayar 2017). In this work, each role is based on a distinct purpose and exhibits different features, whereby tokens can exhibit more than one role. Even though this provides flexibility by compounding different utility factors, we perceive additional utility factors which are not present in the author's proposal, some of which we listed in the previous subsection. To the best of our knowledge, the most comprehensive typology we have identified was proposed by Euler, T., in which the author identifies five dimensions as "*multiple angles from which you can look at tokens*" (Euler 2017). These are the token's purpose, its utility, its legal status, its underlying value and finally the technical layer in which it is implemented on (Euler 2017). From these the author proceeds to identify token archetypes by testing the interplay of different combinations observable in renowned real-world tokens. Despite perceiving the approach as very comprehensive and empirically accurate, we have identified a potential for improvement on three levels. Firstly, we interpret utility as a more volatile dimension than the concept which the author presents. While the author restricts utility to a set of three possible outcomes - usage token, work token or hybrid token - we perceive utility instead as a spectrum which is hardly pre-classifiable due to the high variability in which it can emerge in a specific token (Mougayar 2017; Lena and Oxana 2017). This raises the question whether utility is not exactly a dimension in which tokens can be classified, but rather a high-level description of those tokens which are neither tokenised securities nor cryptocurrencies - a classification which is incidentally heavily used in the blockchain domain (Benoliel 2017; Tomaino 2017b). Secondly, the Purpose dimension - which the author proposes as either Cryptocurrencies, Network Tokens or Investment Tokens - might prove to be a challenge in the face of the many blockchain tokens which exhibit more than one of these purposes simultaneously, some of which not even classifiable in these three options. As we mention in the previous subsection, it is often the case that a token is used because (and not despite) of its multi-purpose abilities. One common case is the interaction between investment and network purpose (Rudolf 2017). Lastly, by limiting the token classification to five dimensions, the authors propose a classification approach which may prove to be overly simplistic in the face of emerging business models built around token utility. Many factors affect token design, and the vast classifications presented in the previous subsection are a proof to this. Nonetheless we perceive this as a very interesting approach which lays down a novel framework on token classification. With this in mind, in the next Subsection we make a first proposal on a similar mental model, based on this Literature Review and later developed further with our empirical study.

Results

First Iteration – Literature Review

With the insights from the Section Related Work we constructed a first iteration of a morphological box, as plotted in Table 1. The eleven token parameters on the first column describe the token along its attributes:

- **Class**: a widely used distinction, thus distinguishing digital money (Cryptocurrencies), from digital shares with entitlement to profit-sharing or dividends (Tokenised Security) and from the remaining crypto-assets (Utility Tokens). This is a key distinction which lends a comfortable categorisation to tokens with attached utility, thereby differentiating them from securities under strict legal supervision (Finma 2018; Bafin 2018; van Valkenburgh 2017) as well as from digital money such as Bitcoin, which as pure means of transaction has different ambitions (Nakamoto 2008).

- **Purpose**: a token exists either because it uniquely represents an asset (Asset-Backed), it confers to its holder an access permission just like an access card does (Usage Token) or it is used as value container to reward a certain behaviour (Work Token) (Tomaino 2017a; Little 2017).
- **Role**: following an existing classification (Mougayar 2017), tokens may bestow a right to its holder (Right), represent a unit of value exchange in an internal system (Value Exchange), depict a fee for pay-per-use or access purposes to a platform (Toll), embody a tool to enrich user experience and reward user behaviour (Function), constitute a *de facto* payment method (Currency) or embody the right to confer profit-sharing to the token holder (Earnings).
- **Representation**: following an existing classification (Glatz 2016), tokens may represent pure digital assets like voting rights or digital identities (Digital), be bound to physical objects as in smart property or smart objects (Physical), be tied to virtual reality objects (Virtual) or represent legal rights granted by law or agreed between parties (Legal).
- **Supply**: describes whether a token supply is fixed and distributed on a one-time basis (Fixed) or behaves according to a specific schedule (Schedule-based) (Chen 2017).
- **Incentive System**: tokens exert influence over the network and its holder through incentives which may be to Enter, Use or Stay Long-Term in a Platform (Lena and Oxana 2017).
- **Transactions**: tokens which can be spent in a platform are considered Spendable, whereas the remaining are Non-Spendable (Lena and Oxana 2017).
- **Ownership**: in most cases tokens' ownership may change hands (Tradable), though there are cases where this is not possible (Non-Tradable) (Yadav 2017).
- **Fungibility**: a fungible asset is interchangeable with another asset of the same category. In the tokens domain, some of them are purely equal (thus perfectly Fungible) whereas others possess distinct characteristics which ensure its uniqueness (Non-Fungible) (Glatz 2016).
- **Layer**: a technical attribute which refers to the distinction on where tokens are based. These can either be native to a blockchain, issued on top of a protocol or on the application layer (Little 2017).
- **Chain**: the chain on which the protocol is based also affects token design. These can be new chains on new code, new chains on forked code, forked chains on forked code or - in the case of application-layer tokens – cases where the tokens are issued on top of a protocol (Srinivasan 2017).

<table>
<tr><th>Class</th><td colspan="4">Coin / Cryptocurrency</td><td colspan="2">Utility Token</td><td colspan="3">Tokenised Security</td></tr>
<tr><th>Purpose</th><td colspan="4">Asset-Backed Token</td><td colspan="2">Usage Token</td><td colspan="3">Work Token</td></tr>
<tr><th>Role</th><td>Right</td><td colspan="3">Value Exchange</td><td>Toll</td><td>Function</td><td colspan="2">Currency</td><td>Earnings</td></tr>
<tr><th>Representation</th><td colspan="2">Digital</td><td colspan="3">Physical</td><td colspan="2">Virtual</td><td colspan="2">Legal</td></tr>
<tr><th>Supply</th><td colspan="5">Fixed</td><td colspan="4">Schedule-based</td></tr>
<tr><th>Incentive System</th><td colspan="4">To Enter Platform</td><td colspan="2">To Use Platform</td><td colspan="3">To Stay Long-Term</td></tr>
<tr><th>Transactions</th><td colspan="5">Spendable</td><td colspan="4">Non-Spendable</td></tr>
<tr><th>Ownership</th><td colspan="5">Tradable</td><td colspan="4">Non-Tradable</td></tr>
<tr><th>Fungibility</th><td colspan="5">Fungible</td><td colspan="4">Non-Fungible</td></tr>
<tr><th>Layer</th><td colspan="3">Blockchain (Native)</td><td colspan="3">Protocol (Non-Native)</td><td colspan="3">Application (dApp)</td></tr>
<tr><th>Chain</th><td colspan="2">New Chain
new Code</td><td colspan="3">New Chain,
forked Code</td><td colspan="2">Forked Chain,
forked Code</td><td colspan="2">Issued on top of
a protocol</td></tr>
</table>

Table 1. Token Classification based on Literature Review

Second Iteration – Empirical Data

Evaluation

After building the first version of the morphological box based on our literature review, we proceeded to evaluate it against our empirical findings. The 16 interviews provided data for 18 different tokens. All eleven parameters present in the morphological box were included in the semi-structured interviews and were object of discussion with the interviewees. Furthermore, we equally focused on possible extensions of parameters and their attributes in the morphological box, along the observations in the tokens being analysed. In the end, our morphological box was extended to 13 different parameters as opposed to the previous eleven which were derived purely from literature. The two added attributes (Burnability and Expirability) were identified while analysing collected empirical data, though they were not previously mentioned in the literature. Table 2 presents the token classification, created based on literature and empirical data:

- **Class**: this attribute was confirmed by our data.
- **Function**: we perceive the term "Function" as a better choice than "Purpose", mainly due to most tokens in our empirical data exhibiting a multi-purpose ability which cannot be plotted in the morphological box. Further, although some asset-based tokens are also backed by these assets, not all of them follow this rule. We thus modified Asset-backed to Asset-Based to allow a more inclusive classification of tokens with direct reference to assets.
- **Role**: while we perceive the valuable contribution of the author for this parameter (Mougayar 2017), we consider "Reward" as a better term than "Function". The reason for this is to stress the reward feature which many tokens possess and which are key to the long-term functioning and sustainability of the platform on which they are based. This was heavily stressed by our data.
- **Representation**: while we understand the basic thinking of the author in suggesting "Virtual" as a dimension (Glatz 2016), we concluded from our data that this may emerge as a superfluous category which may lead to overcomplexity. Our data suggested that tokens' representation is usually limited to Digital, Physical or Legal realms.
- **Supply**: by previously differentiating solely between "Fixed" and "Schedule-based", other possible manifestations were being ignored. Our data suggested the presence of token supply systems which have fixed, pre-mined supply, but different distribution schemes such as one-off distribution vs stepwise distribution (e.g., undistributed tokens locked in escrow which are unlocked via smart contracts based on milestones or simply by time). Additionally, we witnessed the presence of projects with discretionary token supply.
- **Incentive System**: we were able to extend this attribute by one further possibility – a token as an incentive to leave a platform. As an example, this is true for those token holders who perceive the token as a store-of-wealth, but do not wish to remain tied to the platform on a long-term basis.
- **Transactions**: this attribute was confirmed by our data. However, we changed it to "Spendability" to express the ability of the token to be spendable.
- **Ownership**: this attribute was confirmed by our data. However, we changed it to "Tradability" to express the ability of the token to be tradable.
- **Burnability**: a new attribute suggested by our data which reflects that some tokens are purposely burned to create artificial scarcity or to express the extinction of a right or access.
- **Expirability**: a new attribute suggested by our data which distinguishes tokens which expire from those which do not.
- **Fungibility**: this attribute was confirmed by our data.
- **Layer**: this attribute was confirmed by our data.
- **Chain**: this attribute was confirmed by our data.

<table>
<tr><td rowspan="3">Purpose Parameters</td><td>Class</td><td colspan="3">Coin / Cryptocurrency</td><td colspan="2">Utility Token</td><td colspan="3">Tokenised Security</td></tr>
<tr><td>Function</td><td colspan="3">Asset-Based Token</td><td colspan="2">Usage Token</td><td colspan="3">Work Token</td></tr>
<tr><td>Role</td><td>Right</td><td colspan="2">Value Exchange</td><td>Toll</td><td>Reward</td><td colspan="2">Currency</td><td>Earnings</td></tr>
<tr><td rowspan="3">Governance Parameters</td><td>Representation</td><td colspan="3">Digital</td><td colspan="2">Physical</td><td colspan="3">Legal</td></tr>
<tr><td>Supply</td><td colspan="2">Schedule-based</td><td colspan="2">Pre-mined, scheduled distribution</td><td colspan="2">Pre-mined, one-off distribution</td><td colspan="2">Discretionary</td></tr>
<tr><td>Incentive System</td><td colspan="2">Enter Platform</td><td colspan="2">Use Platform</td><td colspan="2">Stay Long-Term</td><td colspan="2">Leave Platform</td></tr>
<tr><td rowspan="5">Functional Parameters</td><td>Spendability</td><td colspan="4">Spendable</td><td colspan="4">Non-Spendable</td></tr>
<tr><td>Tradability</td><td colspan="4">Tradable</td><td colspan="4">Non-Tradable</td></tr>
<tr><td>Burnability</td><td colspan="4">Burnable</td><td colspan="4">Non-Burnable</td></tr>
<tr><td>Expirability</td><td colspan="4">Expirable</td><td colspan="4">Non-Expirable</td></tr>
<tr><td>Fungibility</td><td colspan="4">Fungible</td><td colspan="4">Non-Fungible</td></tr>
<tr><td rowspan="2">Technical Parameters</td><td>Layer</td><td colspan="3">Blockchain (Native)</td><td colspan="2">Protocol (Non-Native)</td><td colspan="3">Application (dApp)</td></tr>
<tr><td>Chain</td><td colspan="2">New Chain new Code</td><td colspan="2">New Chain, forked Code</td><td colspan="2">Forked Chain, forked Code</td><td colspan="2">Issued on top of a protocol</td></tr>
</table>

Table 2. Token Classification based on Literature Review and Empirical Data

We further redesigned the way the above-mentioned parameters relate to each other. Due to the complexity that comes with the interplay of several attributes simultaneously, we decided to group parameters by their role in the token design. In this sense, we were able to identify the following four groups:

- **Purpose Attributes**: Parameters which relate to the high-level purpose of the token. A one-dimensional classification of purpose is difficult to achieve due to the several value propositions of cryptographic tokens, as well as due to the multi-purpose ability which most tokens tend to exhibit currently. By including Class, Function and Role, the token's Purpose is better addressed.
- **Governance Attributes**: These parameters relate to what the token effectively represents and how this connects to the way the platform is governed and managed to assist incentive alignment between all token holders.
- **Functional Attributes**: These encompass "-lity" features which describe which methods can be called upon tokens, and which alter its ownership and/or existence.
- **Technical Attributes**: Parameters referring to the technical dimension of the protocol or application on which the token is based on.

Token Archetypes

Our empirical data further allowed us to identify patterns through the direct instantiation of the tokens along the parameters in the morphological box. These patterns are understood as combinations of parameters from our morphological box. They represent models shared by tokens from similar blockchain applications which play a similar role in their respective business models. In our research, we identify these as token archetypes. Our empirical data further confirmed our initial hypothesis that several tokens exhibit a multi-purpose ability, i.e. that they often serve more than one purpose simultaneously. This provides robustness to the use of token archetypes, since these constitute an ideal mental model to accommodate the complexity which a token can exhibit. Furthermore, our data also suggested that the purpose behind a token is often seen as the main argument behind its inherent utility and long-term value. These findings are equally shared in the literature, as previously mentioned in the Section "Related Work". As such, identifying the individual purpose may be a necessary step to proceed to an assessment of a token's value and role within the underlying business model.

Table 3. Token Archetypes		
Archetype	Main Purposes	Description
Crypto-Currency	Currency	A token with the ambition to become a widespread digital form of currency. *(Cryptocurrency ; Asset-/Usage-/Work-Based ; Currency ; Digital ; Schedule-based / one-time fixed / discretionary ; Use Platform / Stay Long-Term ; Spendable ; Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; Fungible ; Blockchain Native ; New Chain New Code / New Chain Forked Code)*
Equity Token	Earnings, Store of Wealth	A token which confers to its holder a right to equity-related earnings, such as profit-sharing, application rents or platform fees. *(Tokenised Security ; Asset-/Usage-Based ; Toll / Earnings ; Physical/Digital/Legal ; Schedule-based / one-time fixed / discretionary ; Enter Platform / Use Platform / Stay Long-Term ; Non-Spendable ; (Non-)/Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of Protocol)*
Funding Token	Store of Wealth, Funding	A token which is perceived as a long-term investment from the holder's perspective, and as a financing vehicle for the project's team and/or the community (bounties). *(Tokenised Security / Utility Token ; Usage-/Work-Based ; Right / Value Exchange / Toll ; Physical/Digital ; Schedule-based / one-time fixed / discretionary ; Enter Platform / Use Platform / Stay Long-Term / Leave Platform ; (Non-)/Spendable ; Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of Protocol)*
Consensus Token	Validation Reward, Store-of-Wealth	A token which is used as a reward to nodes which ensure data validation and consensus. *(Utility Token ; Work-Based ; Right / Reward ; Digital ; Schedule-based / one-time fixed ; Enter Platform / Use Platform / Stay Long-Term / Leave Platform ; (Non-)/Spendable ; Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol ; New/Forked Code , New / Forked Chain)*
Work Token	Work Reward	A token which is used as reward to users who complete certain actions or exhibit certain behaviour. *(Utility Token ; Work-Based ; Right / Reward ; Digital ; Schedule-based / one-time fixed ; Enter Platform / Use Platform / Stay Long-Term / Leave Platform ; (Non-)/Spendable ; Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of protocol)*
Voting Token	Voting Right	A token which confers a voting right to its holder. *(Utility Token ; Asset-/Usage-Based ; Right ; Physical / Digital ; Schedule-based / one-time fixed / Discretionary ; Use Platform / Stay Long-Term ; Non-Spendable ; (Non-)/Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of protocol)*
Asset Token	Voting Right, Asset Ownership	A token which represents asset ownership. *(Utility Token / Tokenised Security ; Asset-Based ; Right / Toll ; Physical / Digital / Legal ; one-time fixed / Discretionary ; Enter Platform / Use Platform / Stay Long-Term ; Spendable ; (Non-)/Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; (Non-)/Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of protocol)*
Payment Token	Payment	A token which is used as internal payment method in the application. *(Utility Token ; Usage-Based ; Right / Value Exchange; Digital ; schedule-based / one-time fixed; Enter Platform / Use Platform / Stay Long-Term ; Spendable ; Tradable ; (Non-)/Destroyable ; (Non-)/Expirable ; Fungible ; Blockchain Native / Protocol / dApp ; New/Forked Code , New / Forked Chain / on top of protocol)*

Table 3. Token Archetypes

Table 3 lists and describes the eight token archetypes which we were able to identify from our empirical data. A token archetype exhibits main purposes. These are always present for every instantiation of the token archetype and denote the core utility factors of that token. On top of these there might be additional, secondary purposes which are combinable with the main ones, and accordingly extend the token's utility. The description characterises the token's archetype both textually and in its application in the morphological box.

Third Iteration – Evaluation

Car Dossier

Car Dossier is a European-based project consisting of a blockchain-based digital dossier where all data from a vehicle's life cycle can be stored transparently and securely. The information can be accessed and used by different stakeholders. This includes, among others, car manufacturers, parts suppliers, insurance companies, importers, garages, used-car dealers and portals, vehicle evaluators, road traffic administrators, fleet managers, private buyers, sellers and renters, car rental companies and car recyclers. These participants interact among each other within the Blockchain network to produce, validate and curate all events connected to a specific vehicle's lifecycle. The different phases which a vehicle goes through are continuously included and maintained in the ledger. By storing each one of these events in the distributed ledger, it is ensured that every stakeholder possesses at any point in time a clear picture of a specific vehicle's transaction and intervention history, thus being able to make decisions with the best information available. This Blockchain project is a consortium based on a permissioned blockchain. As a joint-project with several different stakeholders from different industries, this means inevitably a large number of possible interactions among them, which can be quite distinct in nature. These include, but are not limited to, money flows, value exchange, data ownership and governance-related issues such as decision rights, among others. Some – if not all – of these interactions may be governed with the use of "car coins", i.e. native Blockchain tokens. As part of the development of the business model, and in line with the stakeholders' vision for the future, the project stakeholders perceived the opportunity brought by the emerging phenomena of Token Sales and questioned whether and how to initiate its own token design. Still open remained the question of what such a Car Coin should represent. This opened the door for launching research on a systematisation of blockchain tokens and the development of a decision tree which determines what the Car Coin token could represent in line with the business model.

Decision tree

Before evaluating our research tool by applying it to the Car Dossier application, we conducted a preliminary workshop with eleven participants active in Information Systems research, followed by individual and joint workshops with the stakeholders of Car Dossier. In the course of these iterations, we were able to construct a decision-aid tool derived from the morphological box and the eight token archetypes (Fig. 2). This allows for an easier application of our morphological box to a specific blockchain project. Our decision tree is use-case driven. These use cases are mapped to the different main purposes identified on our token archetypes. Thus, these Main Purposes were included in the decision tree as application usages ("use cases") for a token. A blockchain practitioner or decision-maker runs through our decision tree from top to bottom, by answering Yes/No questions which address these token use cases individually. The interplay of the adequate token use cases ultimately guides the choice of token archetype. The connection between token use cases (on the right side of the decision tree) and the archetypes (on the left side) can be shaped by two different relations:

- A continuous line stands for token use cases which are always present in a token archetype. This is a 1:1 mapping to the main purposes which we identified in our token archetypes (Table 3)
- A dashed line shows optional use cases which are combinable and often present in token archetypes

A specific token archetype is thus characterised by both mandatory and optional use cases (purposes). As an example, the token archetype "Work Token" always exhibits "Work Reward" and "Store of Wealth" purposes – as these are central to its functions – but may also exhibit other use cases, such as "Funding", "Voting Right" or "Payment" should there be a case for it. This suggests the possibility of tokens with overlapping functions and is in line with the proposed token archetypes in Table 3. Hence, the interplay of all the use cases chosen for a specific token should prevent it from falling in more than one of our eight proposed token archetypes, as the decision on which token archetype is the most appropriate is ultimately determined by the selected use cases. One implication of this is that adding token use cases to a specific token may change its archetype. An example is the case of the Payment token, whose main purpose is solely as a means of internal transactions. Should the token incorporate a new use case such as "Voting Right", then the corresponding archetype is not Payment token anymore, but rather Voting token.

Validation

We organised and conducted a joint workshop with the six stakeholders of the Car Dossier project, who each represent a voice in the consortium. Besides a joint evaluation, in order to attend each stakeholder's expectations towards the token, we additionally conducted an individual workshop with each one of them. This allowed a more detailed discussion on the specificities of the token design from each one's point of view, thus having into account the singularities from each one's core business model and expectations towards the project and a possible token. By applying the morphological box and the decision tree in all workshops, two token use cases were identified as potential applications for this project by all stakeholders: Work Reward and Payment. The former was interpreted as a necessary way to bootstrap the network and attain scale through user rewards, whereas the latter was perceived as an ideal means of exchange within the consortium. The Work Reward led to different, but combinable interpretations of how a Work Reward is represented in the project, depending on each stakeholder's field of activity. Other token use cases were discarded by all stakeholders. This was especially the case for Currency and Earnings, which are respectively aimed at digital money and asset securitisation, both fields where regulatory and strategic requirements are not met. There was fewer consensus on the remaining use cases due to each stakeholder's different ambition and distinct regulatory framework in which they are in. Especially with regards to Funding, Store of Wealth and Validation Reward, we observed different reactions which nonetheless denote different expectations towards the business model. For the purpose of evaluating our tool, we hereby refer to the feedback of the workshops' participants. In the joint workshop, the application of the decision tree enabled a clearer view on how to design a token for the Car Dossier project. Overall, the participants showed satisfaction and enthusiasm with the tools. Specifically, the participants found the morphological box structured and informative, though also mentioning a slight difficulty in understanding some technical concepts. With regards to the decision tree, the participants characterised it as *very informative*, *comprehensive* and *a decision-aid suitable for actors without deep knowledge on token design*. The participants equally highlighted the *easiness of having a step-by-step decision-aid which guides through potential business cases for the token*. On the implications for the future, the participants mentioned having learned about new token roles and purposes which they had not known yet, thus allowing to *revisiting the business model* and *taking a renewed approach towards organising a token emission to the market*. Based on this feedback, we perceive the participants' satisfaction as a very positive adoption of our tools. Whilst the lack of deep knowledge on the topic of token design might have affected the complete understanding of patterns in the morphological box, this was minimised by the usage of the decision tree, whose step-by-step approach guided a supported decision-making on a use-case basis and raised awareness for possible trade-offs and incompatibilities.

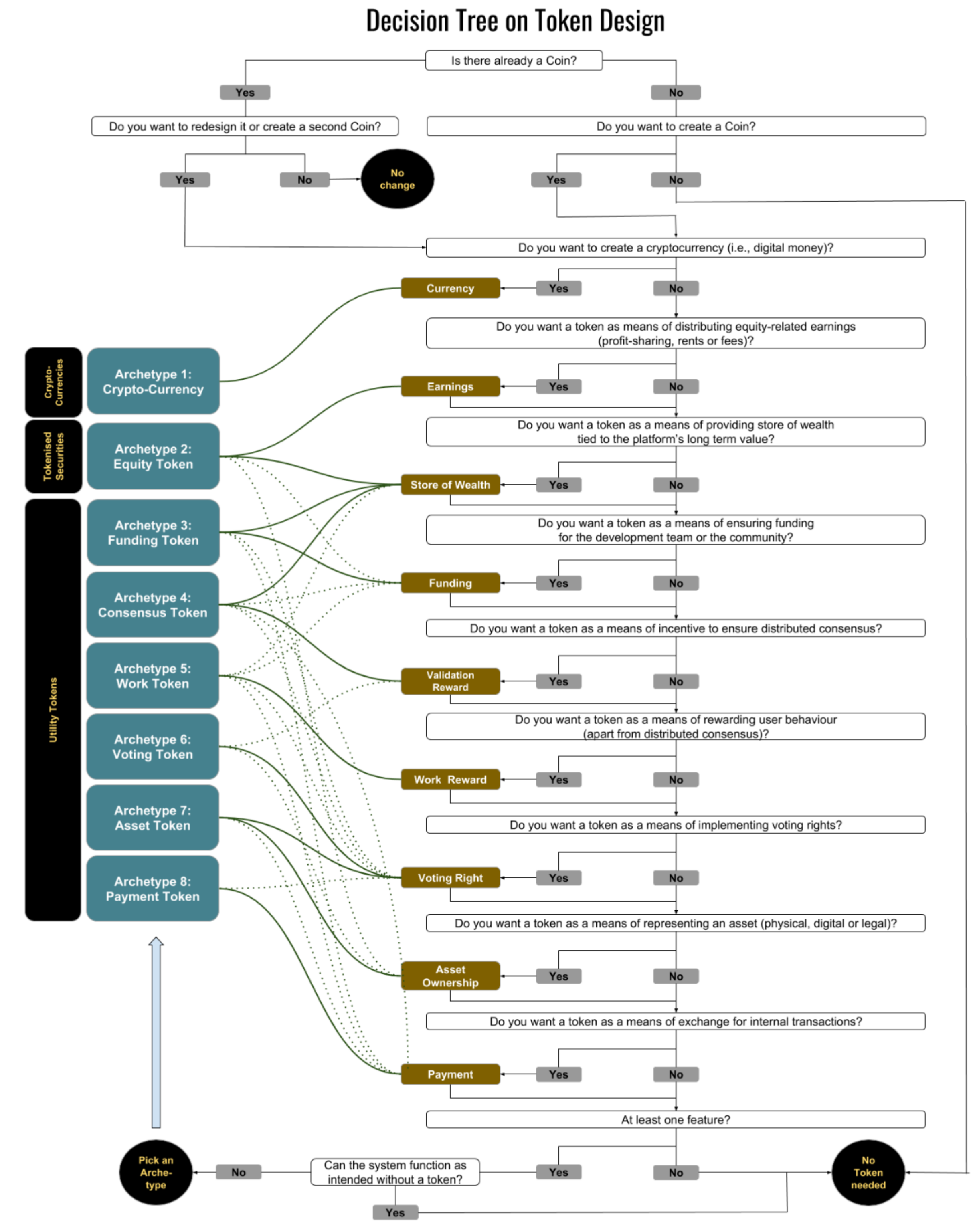

Figure 2. Decision tree on Token Design

Discussion

Our results lead us to the conclusion that the emerging yet fast-growing field of blockchain tokens can be met with structured scientific research aimed at its classification and design. The lack of comprehensive analytical tools from a pure Information Systems (IS) standpoint provides an interesting avenue for further research on these topics. In this sense, the growing attention devoted to *Tokenomics* as a cross-disciplinary research subdomain within Blockchain lays the ground for novel contributions which aim at accurately characterising the current token landscape and possibly shape further developments in this area (Mougayar 2017). We also conclude that literature on blockchain tokens is still heavily based on news articles and domain blog posts, and is heavily influenced by discussion on social media channels. Among the reasons for this is, in our view, a rapid and creative search for disruptive innovation in a new promising technology carrying many transformational changes (Dietrich 2016). While these informal sources allow for a wide range of contributions with viewpoints not often quoted in academia, it is often the case that these inputs are scattered, unstructured or incomplete for proper use by blockchain practitioners. In this sense, comprehensive contributions from IS research can cover the gap by complementing non-scientific inputs from experienced blockchain experts with structured analytical tools which can be used in practice for understanding and deciding tokens.

In our research, we specifically addressed the complexity in token classification by building a morphological box of token attributes based on both literature review and empirical data. Our initial premise on token complexity was confirmed (Lewis 2015). As of writing this paper, we are able to identify at least 13 different parameters on blockchain tokens whose combinatorial interplay allows for the identification of several patterns. Here we stress the importance of combining results from literature review with empirical data. Our empirical study led us to confirm most contributions from our literature review, whilst also providing two additional parameters to which we were not yet aware. The use of empirical data also allowed for refining our initial token parameters and attributes, thereby enriching its accuracy and relatedness to the current real-world token landscape. We believe that further empirical data on blockchain tokens will be able to evaluate and perhaps extend our contribution, thus laying ground for more comprehensive frameworks on this research domain. An interesting avenue for further research may lie in the analysis of incompatibilities between token attributes, thereby making some of these mutually exclusive.

We equally stress the importance of building and updating token archetypes from our empirical data and applying them on top of our morphological box, since these represent patterns which reflect the current token landscape and thus do not stem solely from literature. Designing tokens can therefore be based on already empirically tested concepts. No stranger to this issue is the growing concern devoted to how blockchain tokens must be attached to the increasing search for token utility, both to reinforce its inherent long-term value (Mougayar 2017) and to avoid unwished regulatory pitfalls (Finma 2018; Bafin 2018). One way to achieve this is towards using token archetypes with reference to analytical tools and empirical data. This further allows for bridging knowledge gaps between blockchain practitioners and decision-makers, thus ensuring a proper linkage between tokens and their underlying business model. In this sense, the eight proposed token archetypes are based on real-world blockchain applications and are thus reproducible. Whilst we perceive them as comprehensive and mappable to the current token landscape, it may be the case that additional ones ultimately exist. Nonetheless, our results directly address our RQ1 and pave the way for a first framework on token classification of this kind.

Furthermore, we report on the lack of decision-aids to assist blockchain practitioners on token design and propose a decision-tree which itself is based on our morphological box and token archetypes. Departing from the challenges faced in an existing blockchain application (Car Dossier), we were able to build a second analytical tool which maps the previously found token purposes – which guide the eight token archetypes – to token use cases. This makes our decision tree use-case driven and reflects its applicability in real-world applications. Here we stress how different business models affect different token usage applications, thereby making certain token archetypes more adequate while rendering others obsolete. Our decision tree has the added benefit that it is comprehensive to the point that it covers the parameters in our morphological box whilst minimising the interplay of token attributes which may manifest in contradictory ways. It is also our view that a token is an artefact which makes sense only when the underlying business model commands it. For this same reason we included in our decision tree a question on whether a token is needed in the first place. This question appears deliberately in the end in order to both test and suggest token use cases which may be outside of the knowledge of blockchain practitioners who use the tool. In this sense, the decision tree achieves both the objective of being use-case driven and of bridging domain knowledge. Its structure and sequence flow are also intentionally aware of one of the most utilised token classification matrixes by grouping token archetypes into cryptocurrencies, tokenised securities and utility tokens. The decision tree flow thus provides an informative approach towards decision-making on token design. This might prove especially useful in applications which are either yet tokenless or where the decision process is made collectively, both of which are the case in the consortium of Car Dossier. Our results on RQ2 are thus based on a similar mental model which is already used for questioning the use of blockchain technology (WEF 2018).

Our findings show that innovation in the blockchain domain is still heavily influenced by light literature such as news articles, opinion posts and white papers. Token design is no stranger to this issue. We observed that tokens are still designed based on unstructured frameworks and partially with disregard to the underlying business model. In addition, one of the major challenges in token design lies not only in getting the token utility right, but also in compounding utility, thereby allowing it to improve its inherent value without enabling incompatibilities. This suggested additivity in token utility brings added value to a blockchain application. Tokens' growing usage and complexity in blockchain applications should thus provide additional scope for research, including but not limited to new token usage applications (use cases), token archetypes and decision-aids on token design. Such efforts have the potential to lead to bidirectional contributions between practitioners and research. We believe that the research gap on the domain of *tokenomics* stands wide open for new contributions from different disciplines and has the ambition to achieve positive disruptive change in the blockchain domain.

Conclusion

We report on a literature review and an empirical study across 16 different real-world blockchain-based projects from diverse areas and with distinct business models. We find that there is serious demand in theoretical frameworks which contribute towards comprehensive token classification and token design. We also identify the gap of decision aids which facilitate the process of token design for existing blockchain projects. We contribute to these research gaps by proposing a framework consisting of a morphological box, a list of eight token archetypes and a decision tree which help classify, systematise and structure decision-making on blockchain token design. We evaluate our analytical tools by applying them on an existing blockchain project called Car Dossier and report on its successful adoption and usage.

Our results suggest that there is wide potential in the field of *Tokenomics*, especially with regards to the challenges behind token design. Whilst every other blockchain application is unique, we report on archetypes which depict patterns in the current blockchain token landscape. These are reflected on empirical data and structured on top of our proposed analytical tools. We invite blockchain practitioners to make use of our tools and test their applicability. The observations in our study should nonetheless be seen as tentative and be the object of further study and reproducibility. We admit that there might be additional parameters, attributes and use cases for blockchain tokens which are still not included in our framework but which have the potential to change and perhaps extending it. Further data collection may help achieve this. Next to qualitative data analysis another possibility would be to employ textual analysis techniques to automatically detect and identify new token types. We thus believe to have made an initial contribution towards future work in a rapidly-changing field which can both shape and be shaped by prospective developments in Information Systems Research.

Nonetheless, our research is not without limitations. A substantial fraction of the blockchain applications in our data stemmed from Twitter channels and blockchain-themed news articles, both of which fall outside of the classical source for scientific publications. We interpret this as the result of blockchain being a young yet emerging technology with high ambitions, thereby enabling open lively discussions and information exchange in social media channels and domain news sites. On the other hand, with regards to the observed literature research gap on this topic, we were able to successfully cover it with a novel scientific contribution with reference to the current blockchain landscape. We stress the role of our research into covering this research gap. With regards to potential bias in the collected data, we perceive the shortlist selection as the natural consequence of conducting semi-structured interviews with unknown industry partners. In this regard, we stress the equal treatment of all blockchain projects and the consistent usage of the same interview techniques. Further reproducibility of our methods might help to conclude on the accuracy of our interpretations. Finally, we accept that our proposed analytical tools require a previous knowledge on blockchain domain and specifically basic token design. We interpret this as a necessary limitation of our framework. Decreasing our tools' complexity in favour of increasing potential audience would have had a negative consequence on the deepness and accuracy of our tools. We believe to have found a balance between the use of technical and domain terms, and a tool design which can be understood by both researchers and practitioners, namely in business-oriented domains.

We hope that our work leads both researchers and practitioners towards building improved contributions which more accurately represent the most recent blockchain token landscape and lead the way towards promising approaches with great impact on innovative blockchain-based business models.

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