PEER-REVIEWED RESEARCH

OPEN ACCESS
ISSN Online: 2516-3957
ISSN Print: 2516-3949
https://doi.org/10.31585/ jbba-8-1-(3)2025

Token Classification Framework: Considering the Origins of Value and their Mechanisms of Manifestation

Vasily Sumanov, Jean-Luc Desmarais
Valueverse, Cyprus

Correspondence: v.d.sumanov@gmail.com
Received: 22 July 2024 **Accepted**: 14 February 2025 **Published**: 6 March 2025

Abstract
This article presents the original Token Classification Framework for digital assets (tokens), focusing on the intrinsic value of tokens and acknowledging the significance of demand-side considerations. Traditional classification frameworks overlook these aspects, often assessing tokens based on a wide range of properties, including non-economic ones, without positing a hierarchical structure. In contrast, this work introduces a novel framework that classifies tokens based on their value-capturing roles arising from involved actors' coordination and primary pathways through which value is realised in the system. In particular, a hierarchical three-level model is developed, wherein a token is attributed several origins of value, and interacting origins of value are grouped by a common pathway they are realised through (termed the Value-Capturing Mechanism). Specific technical implementations of these pathways are recognised. In addition, a method of systematic token design is proposed, and criteria for recognising novel Value-Capturing Mechanisms are given. Application of the novel framework is demonstrated for both token design for a model system and the decomposition of an extant token according to its origins of value and Value-Capturing Mechanisms.

Keywords: *Classification Framework, Token Value, Value-Capturing Mechanisms, Origins of Value, Token Engineering*

JEL Classification: *D46*

1. Introduction

Digital assets existing on blockchains (called 'tokens' hereafter) power the economic mechanisms necessary for the maintenance of general acceptance and utilization of blockchains, digital ecosystems, protocols, and dApps. A token in the context of blockchain and digital assets refers to a unit of value issued by a blockchain-based system, typically representing ownership, utility, or access rights within a decentralised network, with the precise technical nature of this unit (e.g., created by an unrelated entity and deployed on a blockchain or built into the blockchain to facilitate block proposal and validation) being immaterial for the purposes of this article.

Understanding the economic functions of tokens integrated into a given system and their relationship to the value of such assets is critical to understanding web3 business models and best practices for creating digital economic systems. For this purpose, the primary object for examination in case of discussing token value should be intrinsic value that is referred to as the value expressed within the given system or network to which the token is integrated and not related to third-party networks or protocols. Therefore, the intrinsic value of tokens was the main focus of this study.

The idea of classifying tokens into some system or framework is not novel. Many token classifications have been proposed in the past five years, starting with Oliveira's influential paper [1]. All of them, however, aim for a general descriptivist approach, seeking to subdivide the tokens according to all the properties that characterise them, such as technical, distribution approaches, etc. However, few, if any, observe digital assets from the view of value-capturing mechanisms, which we believe deserve a primary role in considering the economic structure and functionality of any token.

In this article, we present (1) an overview of the existing token classification frameworks with attention being focused on the demand-side aspects to elucidate the background for this study, (2) the foundations of the proposed classification using so-called origins of value and mechanisms of their manifestations, (3) the classification framework itself, that is also named as Value Capturing Theory, (4) overview of the examples of framework applications, including existing digital assets' decomposition into value-capturing mechanisms and methodology for creating new digital assets, and (5) the Periodic Table for digital assets' value-capturing mechanisms.

2. Literature review

Hereafter an overview of select classifications is presented, which focuses attention on the demand-side aspects, in order to elucidate the background for this study. We further note that differences between tokens, tokenisation, and other related concepts are mostly omitted because they are of scant interest to the classification presented in the study since it disregards the technical and legal status aspects entirely, being instead purely focused on describing the role of the token in ensuring the operation of tokenomic systems and the mechanisms by which it is achieved. We only concern ourselves with one dimension of the token's nature that we deem principal to its operation. For this reason, legal status is rather insubstantial to the focus of the presented. The presented classification can be used as a foundation for future discussion of legal properties.

Oliveira's paper on token classification is certainly one of the more influential and in-depth ones [1]. In it, the authors propose a classification of tokens according to four parameter groups: Technical, Functional, Governance, and Purpose. Technical parameters relate solely to the technical aspects of the layer and chain on which a token is deployed and are, as such, wholly out of scope of our considerations. Functional parameters relate to the technical properties of a token, such as fungibility and spendability thereof; Governance parameters pertain to the token supply model and the incentive system a token implies for the platform it is on; finally, under Purpose parameters, the authors collect properties relating to a high-level purpose of the token. The classification proposed by Oliveira et al. is given in Figure 1.

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

Figure 1: Classification proposed by Oliveira et al. [1].

Regarding the parameter groups presented in the framework discussed, purpose parameters most closely align with a demand-side classification; however, they appear slightly inconsistent, being divided into three subgroups with different aspects. It must be noted that this proposal makes a step towards a hierarchical classification, wherein, as in real design processes, functional and technical parameters are subordinated to the value-originating purpose of the token by introducing token Archetypes. However, the Purpose parameters enter the Archetype description as just that – parameters and the main purposes of these prototypical tokens are not codified anywhere, forming a set of their own. Regardless, this paper, which has influenced a good deal of subsequent work, may propose a hierarchical classification, albeit in a rudimentary form.

The other classification proposed by Euler also aims to attain a general description of a token as a member of several classes, considering it in all dimensions, even legal, not being excluded [2]. The classification proposed by Euler is given in Figure 2.

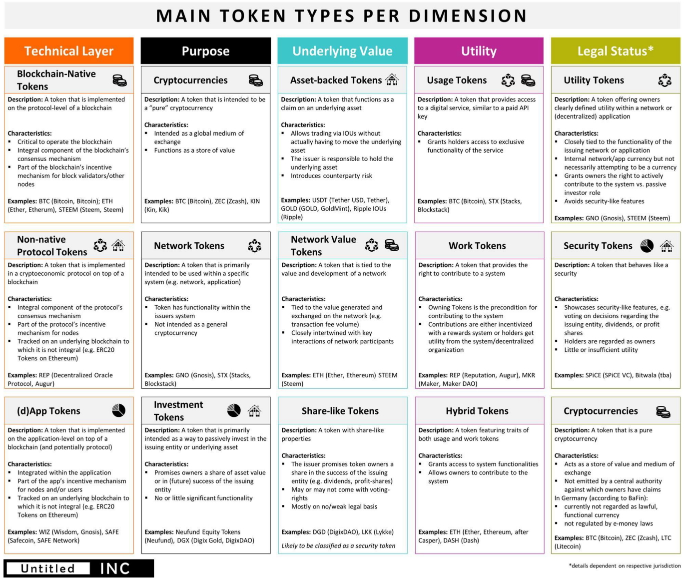

Figure 2: Classification proposed by Euler [2].

This work has much in common with Oliveira's previously discussed work, influencing it and being cited there. However, a separate focus on the origin of token value was also made. Of the dimensions recognised by Euler, Underlying Value and Utility are related to the demand side, and even then, they can be argued to be much too general. The presented token types describe properties and partly the value origin but lack a detailed description of the value-capturing mechanisms (except for share-like tokens, which are the closest example to traditional finance).

Another extensive work is the taxonomy report compiled by the experts of CryptoCompare [3]. A large number of existing classifications are considered in this study. However, here we discuss only the original contribution. CryptoCompare's classification is again much broader than just the supply side. Similar to Oliveira, the authors divide archetypes, which are meant to encode certain common types of tokens, from certain 'natural groupings', which are meant to represent general aspects of them. Again, as in Oliveira et al., the archetypes occupy the top layer of the hierarchy, this time more strongly induced. Since we are most interested in the demand-side classification, we present here only the natural grouping recognised in the report that relates to the demand side: that of a rationale for owning tokens, which corresponds to the origin of their value, shown in Figure 3.

This classification is as detailed as Oliveira's, although it has the additional property of recognising the importance of the rationale for owning tokens, i.e., the origin of their value, which gives people the desire to obtain and use them. It should be noted that while a category of demand factors is recognised as worthy of distinction, the subordinate relationships between technical details and said demand factors are hardly developed, even though the latter is, of course, the foundation of token design.

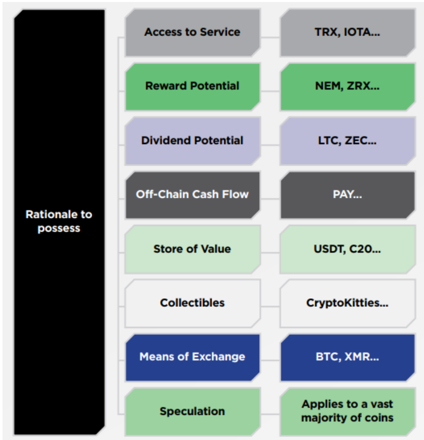

Figure 3: Classification proposed in the CryptoCompare report [3].

The most recent work considered, Freni's classification system, builds on the previous work by combining the systems proposed by other authors to obtain a general framework [4]. It is pretty close to Oliveira's and CryptoCompare's proposals in terms of demand-side classification. The full classification framework is shown in Figure 4. The Coordination section provides some information on value capture, reflecting the basics of what the token owner can do with the token, defined as Incentive Enablers, and what is possible to get in return (e.g., discount, cash flow, Incentive Drivers subsection). The interrelationships of Incentive Enablers and Incentive Drivers, which explain the causal relationship between the token utility function and the intrinsic value, can be considered the key result of this study in exploring the value capturing of digital assets.

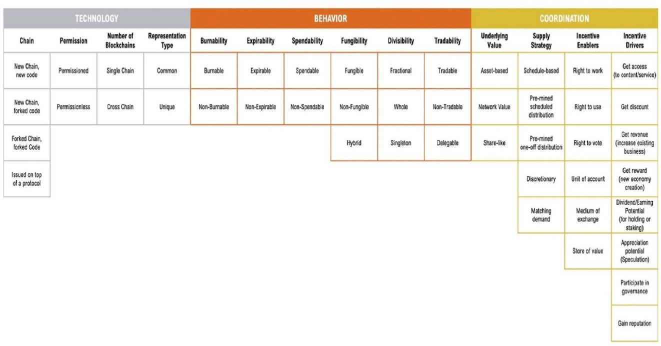

Figure 4: Classification proposed by Freni et al. [4].

Another multidimensional classification was developed by the International Token Standardisation Association with the purpose of developing a universal alphanumeric code for any arbitrary token to enable its brief characterization [6]. The general overview of the dimensions is given in Figure 5.

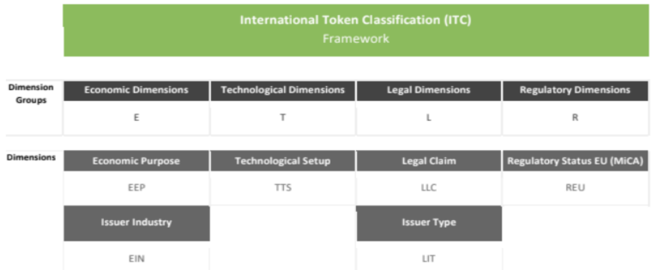

Figure 5: ITC classification overview [6].

Most of the dimensions are not directly related to the value of the token and its origins (since the classification was done with a complete classification of all features in mind). The only dimension relevant to our study is the Economic Purpose dimension. Within this, the highest sub-level (the category level) contains only payment, investment, and utility tokens (reflecting the general legal approach discussed next, rather than a consideration of the source from which the value is derived). Further sublevels of classification (subcategories, classes, and subclasses) capture many token cases, though not all that we distinguish (e.g., the work token is not distinguished; it is likely subsumed into an access token). A list of selected economic token categories, along with their ITC levels and descriptions, is provided in the Appendix.

In addition, the growing popular engagement with cryptocurrencies has led to an increased interest in the development of legal instruments to regulate them. As a delineation of the source of value already exists for goods (e.g. distinguishing between commodities and securities), it is expected that some classification of tokens along these lines will be proposed. Indeed, a number of regulatory classifications exist in both the EU and the US. Since the economic classification therein is mainly concerned with fitting the tokens into extant legal categories.

In the EU, the Markets in Crypto-Assets (MiCA) regulation has been passed in 2023 [7]. This regulation divides crypto-assets, defined therein as digital representations of value or rights that can be electronically transferred and stored using distributed ledger technology or similar technology, into the following categories:

1. Asset-referenced token, meaning a type of crypto-asset that purports to maintain a stable value by referring to the value of several fiat currencies that are legal tender, one or several commodities, or one or several crypto-assets, or a combination of such assets (essentially a stablecoin pegged to several currencies or some other token)
2. Electronic money token, meaning a type of crypto-asset the primary purpose of which is to be used as a means of exchange and that purports to maintain a stable value by referring to the value of a fiat currency that is legal tender (essentially a stablecoin such as Stasis Euro [8])

3. Utility token, meaning a type of crypto-asset that is intended to provide digital access to a good or service, available on blockchain, and is only accepted by the issuer of that token

This distinguishes two types of stablecoin: an access-control token (not a pure access token in our classification, since it includes, e.g., tokens of reward pools), and all other assets that fall outside the purview of this regulation.

In the United States, tokens are mainly classified as either securities, overseen by SEC, commodities, overseen by CFTC, or neither, and scant official classification in the vein of MiCA exists [9]. The SEC has no official stance on whether virtual currencies (value media) are commodities, the CFTC states that they are definitely commodities, tokenised securities are securities, utility tokens may be commodities, or they may be neither securities nor commodities. Virtual currencies are here defined as any digital representation of value (a 'digital asset') that functions as a medium of exchange, and any other digital unit of account that is used as a form of a currency (i.e., transferred from one party to another as a medium of exchange); they may be manifested through units, tokens, or coins, among other things, and may be distributed by way of digital 'smart contracts', among other structures [10]. Regarding classification of tokens as securities, it is done purely by applying the Howey test, which demands that securities meet the criteria of 'an investment contract exists if there is: (1) an investment of money; (2) in a common enterprise; (3) with a reasonable expectation of profits; and (4) to be derived from the entrepreneurial or managerial efforts of others.'. As a corollary, a token may be considered as a security at one point (during an Initial Exchange Offering) and cease to be once the product is launched [9].

2.1 Literature review conclusion: Why should we focus on origins of value?

A review of previous work shows that modern classification thought is predominantly concerned with creating broad classifications that capture every facet of a token's characteristic property set. The hierarchical depth is relatively low and usually not pronounced. No particular emphasis is placed on the demand-side factors, mainly due to the desire to create an all-encompassing classification. As a result, it often conflates the origins of value and the mechanisms by which these origins produce value. Many classifications also aim for compatibility with regulatory classifications, but the latter's narrow focus and sometimes ad hoc nature (as in the US case) are to the great detriment of the classifications thereby produced.

In this article, we demonstrate that it is possible to create a framework within which the characteristic multi-purpose nature of tokens can be realised by combining atomic units of value-originating purpose.

Creating a demand-side classification requires understanding the origin of demand, i.e., the value users receive from interacting with a token that compels them to seek that interaction. This inevitably leads to a natural classification based on different answers to this question, which have been repeated in many previous works under different names. However, all such classifications elucidate the role of the token and, thus, how value is granted to the user and not the origin of that value.

For this reason, we propose a classification based primarily on recognising separate origins from which a token's value is derived. In addition, it is hierarchical, with value-capturing mechanisms – i.e., general behaviour patterns that allow a token's value to be manifested and exploited – subordinate to value origins and all technical particularities subordinate to value-capturing mechanisms. Since the atomicity of the highest level classes is an important factor in our considerations, the classification framework is also made modular, giving the framework users the ability to easily form their own value-capturing mechanisms or implementation patterns based on origins of value.

3. The proposed token classification framework

3.1 General points of consideration

The proposed classification framework builds on our approach of separating the origins of value from the mechanisms for activating it, thus moving away from the prevailing two-tiered classifications to a three-tiered one. To that end, the proposed three-tiered classification is composed of:

1. Origins of Value (OoVs)
2. Value Capturing Mechanisms (VCMs)
3. Value Capturing Implementation Patterns (VCIPs)

The Origin of Value (OoV) is an elementary economic pattern reflecting the value that arises from coordinating agents within the network, for example, by engaging in Ethereum block production. Origins of Value depend on existence of some kind of coordination value in a given system.

Value-capturing mechanism (VCM) is a particular economic mechanism composed of interacting origins of value. The VCM design space is filled with sets of possibly multiple origins of value whose value can be extracted via a specific behavioural pattern.

Value Capturing Implementation Patterns (VCIPs) are code implementations of Value Capturing Mechanisms in a particular protocol or network. The particularities of technical implementation appear only at this hierarchical classification level.

We opine that this structure of decreasing abstractness has the additional benefit of allowing a clearer view of the similarity between tokens with respect to their ways of generating value, even if implementation details differ greatly.

3.2. On the value

We have already considered the origins of value and their combinations (as well as activation pathways) thereof as the principal way of token classification. However, we need to discuss what is value and its components.

In our view, the value of digital assets should be described in terms of a formal optimization problem; this is natural in the framework of rational economic agents. We propose the following form for it:

$$U = Q(p, x, s, t) - L(p, x, s, t)$$

where Q represents the general utility of holding x tokens at price p, given the blockchain state s and the holding time t (where it must be said, it is the time of specifically holding the token in its value-activation form).

The L, in turn, represents the general risk or expense associated with the same. If U is negative, the token is not worth holding and is, consequently, not held if all economic actors act optimally; if U is positive, however, the token is held readily and appreciated. We disregard speculative value because it is non-specific and extrinsic; it is born purely out of the suboptimality of market evaluations of tokens, and we, as shall be stated further, assume the induced optimisation problem is always solved.

It becomes possible to cast the price and token distribution at any point in time as formal solutions to the following optimisation problem:

$$p^*, x^* = \arg\max_{p,x} U$$

Although this problem seems simple in form, the target function is indeterminate and is, as a rule, neither convex nor simple; for this reason, optimisation is purely formal and is assumed to be carried out by the market itself.

It behoves us to also acknowledge the commonly accepted economic theories of value. The marginalist approach that considers differential utility as a source of value lies closest to our consideration, although it does not match entirely[10]. Let's consider, for example, how our approach explains the paradox of value: the discrepancy in prices of water and diamonds comes about precisely because of the differing subjective value functions [11]. The amount of expenses and efforts that should be made to obtain them is so high that for the general value (which was almost purely hedonic in Smith's age - that is to say, a symbol of affluence) to be high enough to make diamond procurement viable, the price must be very high, thereby increasing the hedonic value, as a pricier good can better serve to demonstrate one's wealth.

It will be seen that the explanation based on our approach is quite close to the marginalist one (which takes into account the relative abundance of these two goods), but the differential concerns enter it only in the actual determination of the equilibrium prices (which is done by the economic agents themselves).

3.3. Origins of value

The general value function U that reflects the intrinsic value of a given token is decomposed within the presented equation into a purely nonnegative Value term and a purely nonpositive Loss term. Therefore, since they are atomic, origins of value can be separated into those that add to the value term and those that add to the loss term. Thus, the Origins of Loss are introduced. However, this term isn't used further, labelling everything as Origins of Value.

It must be noted that Origins of Loss should not be understood as pure sinks of value that beget loss only. Their pure loss-generation nature is realised only from the holder's perspective since the holder is thereby exposed to additional risk or obligated to undertake action, imposing expenditure of time and resources. However, the underlying cryproeconomic system is liable to derive value from it (e.g., decreasing the possible loss due to user misbehaviour and the resulting disruptions).

The list of origins of value (eight in total):

- **Value Transfer (#1).** This origin of value represents the intrinsic value gained from the ability to be involved in transactions as a medium of exchange for the value of other assets.
- **Future Cashflow (#2).** This origin of value represents the future income stream exposed by the token and is related to using the token within the protocol.
- **Governance (#3).** This origin of value represents the value gained by the exertion of influence on the management/distribution of limited resources
- **Access (#4).** This origin of value represents the value of granting access to some specific resource
- **Representation (#5).** This origin of value represents value that is extrinsically sourced and comes from representing a unit of some other asset
- **Hedonic value (#6).** This origin of value represents value that is gained as a result of a social contract, e.g., as a result of popularity or other context not captured by the regular economic models
- **Risk exposure (#7).** This origin of value represents a potential loss (in the probabilistic sense) corresponding to deliberate exposure to certain risks (of alienation or depreciation) acting as a necessary condition for activation of other origins of value
- **Conditional action (#8).** This origin of value represents expenses corresponding to a need to carry out certain specific actions to activate value capturing of other OoV (e.g., perform work to receive a cashflow or vote to gain the governance value)

Labelling the outlined Origins of Value by ordinal numbers, we can decompose the general value function additively (δi is an indicator function, taking the value of unity or zero, depending on the presence of a given OoV):

$$U = Q - L = \Sigma \delta_i Q_i - \Sigma \delta_i L_i$$

We summarise the dependence of Origins of Value on the generalised coordinates of p, x, s, t in Table 1:

Table 1. Dependence of Origins of Value on generalised coordinates

OoV	p	x	s	t
Value Transfer	+	+	+	-
Future Cashflow	-	+	+	+
Governance	-	+	+	+
Access	-	+	-	-
Representation	-	+	-	-
Hedonic Value	-	+	-	-
Risk Exposure	+	+	+	+
Conditional Action	+	+	+	+

3.4. Value-capturing mechanisms

A Value Capturing Mechanisms (VCMs), as stated earlier, is a member of the power set of Origins of Value; it has to do with the pathway along which value begotten by a number of interacting origins manifests. Therefore, while Origins of Value define where the value comes from, the VCM defines how this value is manifested. They can be said to define a token's behaviour. Though they are less atomic than OoVs, each still represents one function of a token, and thereby, a single token does not need to possess only one VCM. Hereafter, we list the most frequently employed VCMs.

We present the most widespread VCMs at Figure 6.

Figure 6. Pictorial representation of value-capturing mechanisms. Smaller numbers in brackets correspond to OoV numbering.

The list of most common non-trivial VCMs (containing more than one interacting OoVs):

- **VCM: Work Token.** A token with this VCM is staked into the protocol or otherwise exposed to slashing, after which tasks (necessary to perform network services) must be completed. Successfully completed tasks are rewarded, and dishonest/malicious behaviour is penalised (stake is slashed). The reward can be thought of as the future cashflow for a token stake. **OoVs:** Future Cashflow (#2); Risk Exposure (#7); Conditional Action (#8);
- **VCM: Consensus Token.** This can be seen as a subset of Work token for a special nature of job (proposing and attesting to new blocks) and its consumer (largely unspecified, at least the entire set of chain users, but can be argued to include also the potential chain users; quite close to a public good, in fact). In addition, the natures of job owner and payment are also special: the chain itself acts as a job owner, as the job is set up by design in the initial chain logic; the chain itself likewise disburses payment via a dedicated payment algorithm, which may include dedicated emission and fee collection. **OoVs:** Future Cashflow (#2); Risk Exposure (#7); Conditional Action (#8)
- **VCM: Discount Token.** This VCM imparts value to a token through its ability to grant access to receive a limited amount of discounts on purchases from the company, DAO, or any type of blockchain-powered network [6]. The rebate itself can be argued to represent a form of future cashflow (since receiving a discount is equivalent to paying full price and then receiving a partial refund). The amount of cashflow depends on the amount of purchases, which means that a conditional action is required to activate this mechanism.
  OoVs: Future Cashflow (#2); Conditional action (#8)
- **VCM: Generalised governance.** This VCM gives value to a token by granting the ability to influence decisions of a DAO or protocol related to allocating limited resources (both monetary and non-monetary). Note that generation value from voting requires participation in the voting process, so the conditional action OoV is part of a mechanism structure. **OoVs:** Governance (#3); Conditional action (#8);
- **VCM: Meta pattern.** In this example, it is a generalisation of a Representation token, which can wrap any number of tokens and compose them with arbitrary additional functionality. **OoVs:** Representation (#5)*N

3.5. Implementation patterns

In our three-level system, implementation patterns occupy the lowest level and correspond to the most detailed token description; in fact, patterns do not correspond to abstract origins of value or their modes of manifestation, but rather to concrete tokens, or groups of them, united by common technical details.

An implementation pattern combines an element of the VCM power set and a set of properties, data structures, and algorithms that provide a working token by implementing the VCMs.

4. Application of the presented classification framework (Value Capturing Theory)

4.1. Using the framework for token classification

Firstly, the origins of value are to be identified.

The first step is to identify the goals and problems the ecosystem has, and a selection of policies necessary to satisfy or resolve them (e.g., adding node staking if it is desired to incentivise consistent performance and discourage malicious behaviour); then one should study the closest analogues and determine the sources of value they introduce and the mechanisms by which those sources manifest value.

An inverse approach is also feasible: instead of starting from the problem at hand, one may ruminate on the consequences of introducing a particular OoV into the system and consider what policies may follow thence and what mechanisms ought to be employed to manifest the emergent value.

Secondly, VCMs are to be selected. At this stage, we suggest using the graphical representation presented below and considering the OoVs as a graph, which will generally have more than one connected component. In this graph, nodes correspond to origins of value, and edges represent dependency relations.

Having obtained a graph, one can then recover the VCMs by looking at the connected components; each VCM must correspond to a connected component. This makes it easy to see which VCMs to use and assess whether introducing new mechanisms is appropriate.

The presented classification can be used by token holders, investors, and token designers

4.2. Graphical representations and examples

For an easier understanding of the interrelation of OoV–VCMs–VCIPs in the design of a particular token, we propose the sample graphical interpretation:

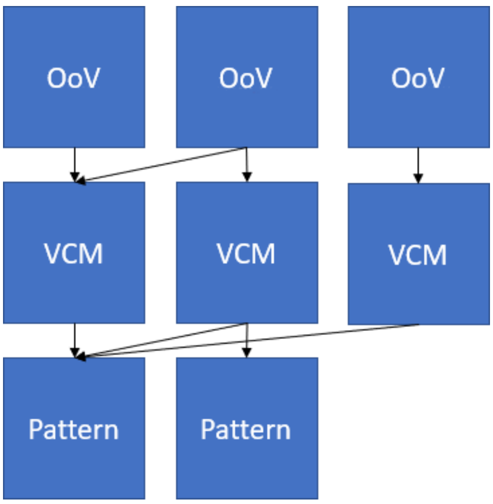

Figure 7: The tripartite hierarchical structure of the presented classification framework. Arrows indicate subordination.

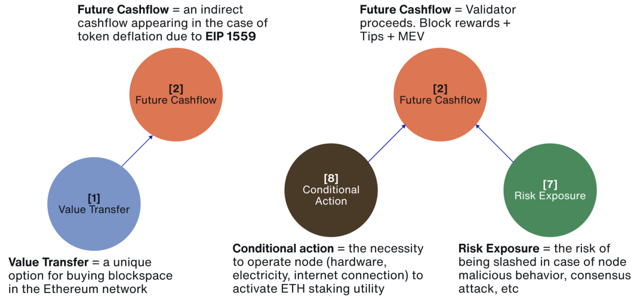

Figure 8: The Ethereum token presented as a combination of Value Transfer and Consensus token VCMs with composite OoVs and their interactions.

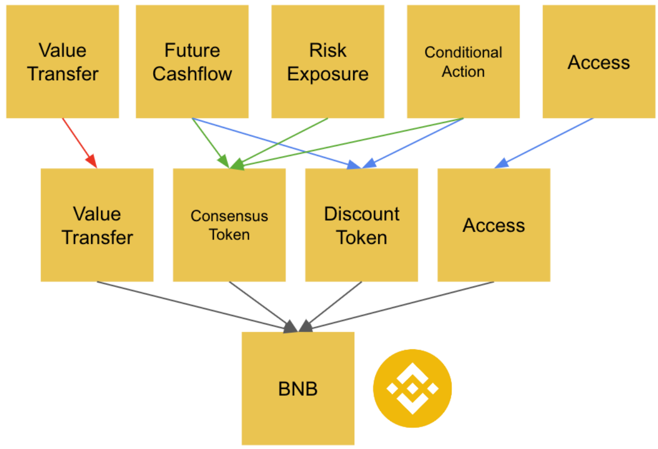

Figure 9: Dependency hierarchy of BNB. OoV-VCM dependencies are colour-coded for convenience.

More examples are presented in Supplementary.

4.3. A workflow for a novel token design

We can further recommend a general workflow for de novo token design based on the presented Value Capturing Theory:

1. Define a system the token is integrated into; define for it the (a) interacting agents (b) principal value and information flows (c) key system metrics

2. Recognise the system goals and issues; define the metrics to be maximised and the issues to be avoided.

3. Determine correct (leading to metric maximisation and goal fulfilment) and incorrect (leading to a decrease in metrics or manifestation of an attack) agent behaviour.

4. Determine a way of agent coordination so that desirable behaviour is incentivised and undesirable behaviour is disincentivised.

5. Knowing the above, propose mechanisms of agent coordination. Recognise origins of value therefrom.

6. Group interacting origins of value (see section 9). Recognise extant or introduce new Value Capturing Mechanisms.

7. Construct or select an implementation pattern based on the selected VCMs.

8. Select the necessary model and operational parameters based on system analysis and simulation.

4.4. On the novel value-capturing mechanisms creation

As stated, a token may manifest value via multiple value-capturing mechanisms. However, what are the conditions for designating new VCMs in token analysis or design?

We opine that two cases are possible: in the first case, there is no extant VCM that captures the interacting origins of a token's value.

In the second case, VCM exists, but the token under consideration has a sufficiently modified form of at least one OoV, making the usage of the extant designation inconvenient.

This measure is only for convenience; for example, a yield-bearing token that requires long-term staking and some other interaction to generate the yield would fit under a Work token in our VCM model. While technically correct from a classification standpoint, this designation would understandably confuse many users, so in such a case, it would be permissible to separate a distinct subtype of the Work token in which the Risk Exposure OoV takes a price-related form, i.e., the risk is limited to the potential depreciation of the token (risk is taken due to long-term lock-ups) and not its alienation.

It is recommended to create new VCMs when it is impossible to accurately represent the totality of OoV interaction for a token as a combination of existing VCMs or it is permissible to create VCM subtypes when a particularity of value capture requires emphasis. In all other cases, we recommend instead representing the token's mechanism as a combination of existing VCMs.

4.5. On the applicability of the proposed model in general

The model possesses a certain usefulness not only for token designers but also for general users. On a qualitative level, the graph representation makes available a number of succinct pictorial representations of the token's pathways of value capture, thereby facilitating analysis of the token's investment potential beyond what is generated speculatively.

Moreover, the classification of value-capturing mechanisms as groups of distinct origins of value makes it possible to induce a number of quantitative metrics for a more in-depth user and investor analysis of a token or, indeed, a group of tokens sharing a similar design.

5. Periodic Table for value-capturing mechanisms

We find it advantageous to present the groupings of mechanisms we have defined by organising them in a table, where the dominant origin of the value is the number of OoVs manifested by a particular VCM. The resulting table, inspired by the well-known periodic systematisation of chemical elements, is shown in Figure 10. The columns correspond to the dominant OoV in our enumeration (which necessarily implies that some columns will probably never have VCMs, at least not practical ones), and the rows correspond to the number of OoVs manifested by a given VCM. Meta-mechanisms are separated into their own row, expanded below the main table.

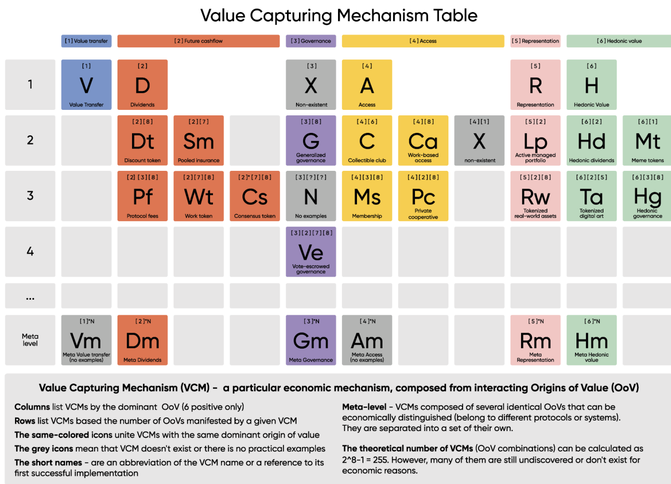

Figure 10: The periodic table of VCMs.

Each element is colour-coded; grey is used for those assumed non-existent or unknown at the moment of creation of this table, and it has OoVs listed at the top of its cell. The short names, likewise inspired by the chemical element systematisation, are assigned either as an abbreviation of the VCM name or as a reference to its first mainnet implementation (e.g., the Sm VCM is named after the AAVE Safety Module).

6. Conclusion

In this article, we considered a novel, hierarchical, demand-side classification of tokens according to their origins of value, the value-capturing mechanisms that manifest them, and particular token implementation patterns (much like archetypes of certain existing frameworks) that represent combinations thereof that constitute a given token or a group of technically similar tokens.

A comparison with existing classifications shows that ours is more atomic in that individual value origins, which are considered to be the bedrock upon which the entire token design process rests as they dictate the behavioural and technical requirements of the token in question, are indivisible, unlike their closest counterparts in existing frameworks.

Furthermore, a method for determining the necessity of constructing new VCMs is given, and a formal optimisation problem treatment of value generation is considered; furthermore, a novel concept of loss generation (i.e., generation of purely negative value) is introduced. The application of a new classification has been demonstrated for both application directions: (1) designing the token functions for the model system and (2) decomposing known examples of tokens into OoV and VCMs.

Competing Interests:
None declared.

Ethical approval:
Not applicable.

Author's contribution:
Both authors equally contributed to the framework design and the manuscript creation.

Funding:
None declared.

Acknowledgements:
VS would like to thank Angela Kreitenweis and Sebnem Rusitschka for providing valuable feedback on this research.

References:

[1] L. Oliveira, et al., "To token or not to token: Tools for understanding blockchain tokens," in *Proceedings of the International Conference of Information Systems (ICIS 2018)*, San Francisco, USA, December 2018. [Online]. Available: https://doi.org/10.5167/uzh-157908.

[2] T. Euler, et al., "The token classification framework: A multi-dimensional tool for understanding and classifying crypto tokens," August 2019. [Online] Available: http://www.untitled-inc.com/the-token-classification-framework-a-multi-dimensional-tool-for-understanding-and-classifying-crypto-tokens.

[3] P. Freni, E. Ferro, and R. Moncada, "Tokenomics and blockchain tokens: A design-oriented morphological framework," *Blockchain: Research and Applications*, vol. 3, no. 1, p. 100069, 2022. ISSN: 2096-7209. https://doi.org/10.1016/j.bcra.2022.100069. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S2096720922000094.

[4] L. Marshall, A. Repin, and C. Tsavliris, "Cryptoasset taxonomy report 2018 – CryptoCompare," 2018. [Online]. Available: https://www.cryptocompare.com/media/34478555/cryptocompare-cryptoasset-taxonomy-report-2018.pdf.

[5] M. Zargham and S.G. Nelson, "Raising social capital: Tokenizing a customer-driven business an introduction to discount token economics," 2017.

[6] P. Sandner, et al., *International Token Classification. Framework Documentation.* Tech. rep. International Token Standardisation Association, 2021.

[7] European Parliament and Council of European Union, *Proposal for a Regulation of the European Parliament and of the Council on Markets in Crypto-assets, and amending Directive (EU) 2019/1937.* 2023. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0593.

[8] Stasis, "EURS: The most trusted euro-backed stablecoin," *Stasis.net.* [Online]. Available: https://eurs.stasis.net/. Accessed July 22, 2024.

[9] Y. Guseva, "A conceptual framework for digital-asset securities: Tokens and coins as debt and equity," *Maryland Law Review*, vol. 80, p. 166, 2020.

[10] Retail Commodity Transactions Involving Virtual Currency, 82 Fed. Reg. 60,335.

[11] E. Von Bohm-Bawerk, *The Positive Theory of Capital - Scholar's Choice Edition.* Creative Media Partners, LLC, 2015. ISBN: 9781295990498.

[12] A. Smith, *An Inquiry* into *the Nature and Causes of the Wealth of Nations. History of Economic Thought Books. McMaster University Archive for the History of Economic Thought, 1776.* [Online]. Available: https: //ideas.repec.org/b/hay/hetboo/smith1776.html.

Appendix

In Supplementary Table 1, we provide examples of classified tokens using the presented framework as supplementary information.

Supplementary Table 1. Token classification examples

Token	OoVs	VCMs	Implementation pattern	Comments
BTC	1	Value transfer	Original PoW bitcoin blockchain	
ETH	1, 2, 7, 8	Value transfer, consensus token	Ethereum 2.0 PoS system with EIP1559	The original Ethereum PoS consensus
stETH	5	Representation	Lido rebasing staked ETH	The original implementation for granting the Ethereum consensus participation proceeds in a gasless way via token re-base model
WBTC	5	Representation	Simple ERC20 version of BTC	ERC20 BTC backed by BTC on bitcoin with KYC/AML when minting
DAI	5	Representation	Collaterazied debt position	First CDP-based stablecoin
cETH	5	Representation	LP token of a lending pool in Compound	
USDC	5	Representation	ERC20 contract controlled by the Circle, the USDC issuer	
UNI	3, 8	Governance	Compound governance	Uniswap uses Compoun governance implementation
LINK	1, 2, 7, 8	Work token, value transfer	LINK implementation of a work token (with payments in a protocol native token)	
FIL	1, 2, 3, 7, 8	Blockchain service network	A file storage blockchain network	A new mechanism having attributes of a consensus and a work token, where block proposers are also the network service providers (file storage)
LPT	2, 7, 8	Work token	Work token with delegation option and slashing	Livepeer original implementation of work token with delegation option
LDO	3, 8	Governance	DAO governance token	
FXS	2, 3, 5, 8	Governance, representation, dividend token	Frax Share model	
MKR	2, 3, 8	Governance, dividend token	Original MKR governance and protocol fee burning implementation	Indirect dividends via MKR token burning as protocol fee payment (DAI's CDPs interest rate)
AAVE	2, 3, 7, 8	Pooled insurance + governance	Original AAVE implementation of governance and protocol pooled insurance (the Safety Module)	
CRV	2, 3, 7, 8	veToken	veToken model by Curve	The original voter-escrowed model with governance rights granted proportionally to the duration of the token lock-up
CVX	2, 3, 5, 8	Metagovernance	CVX meta-governance implementation	The original model based on accumulating veCRV and transferring voting rights to vlCVX token holders
LQTY	2	Dividend token	Pure dividend token granting pro rata shares of protocol income	LQTY original implementation of governance-minimized protocol token
BANK	3, 4, 8	Access token, governance	Simple snapshot governance	Tiered community access