Toward a Definition of Blockchain: Analyzing Definitions to Propose a Definition

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Abstract: Definitions serve a range of purposes, including providing meaning to a term, describing the characteristics of an object being defined, eliminating any ambiguity about the meaning of a term, demonstrating the etymology of a word, and so on. However, scholars hold differing opinions on everything from the necessity of definitions to the very existence of definitions. This disagreement is evident in various definition theories, types, and methods. This article aims to provide a tentative definition of blockchain using the Aristotelian method of definition, after thoroughly examining existing definitions in the literature. Many publications were collected from multiple databases to achieve this, and non-peer-reviewed literature was excluded. Subsequently, definitions were extracted from the literature using a semi-automated method, creating a mini corpus of definitions, which was then analyzed. During the analysis, it was observed that authors employ eleven class terms and several distinguishing characteristics to define blockchain. However, ten of the class terms were deemed unsuitable based on the analysis, and the definition was ultimately made on the concept of Distributed Ledger Technology (DLT). Nevertheless, the proposed definition is presented as tentative due to the absence of a precise definition for DLT and the ongoing evolution of blockchain. In the field of information systems, defining concepts logically is a rare occurrence caused by professionals' unfamiliarity with communication and logic principles. This study aims to provide a tentative definition of blockchain that will enable interested parties to have a consistent understanding of the term and lay the groundwork for future definitions in this domain.

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"If terms be incorrect, language will be incongruous; and if language be incongruous, deeds will be imperfect" (Confucius 1996, 68)

1.0 Introduction

Definitions serve a multitude of purposes, including but not limited to ascribing meaning to a term, elucidating the characteristics of an object under definition, eliminating any ambiguity surrounding the meaning of a term, and tracing the etymology of a word. There has been a longstanding scholarly discourse surrounding the essence, objectives, and indispensability of definition. While some scholars, such as Schiappa (2003), place significant emphasis on the importance of definitions, others, such as Wittgenstein (1968) and Fodor (1981), illustrate the challenges inherent in defining certain concepts. Nevertheless, Carnap (2003), a proponent of the significance of definition, underscores that definitions establish both a necessary and sufficient condition for forming and utilizing a concept.

In the contemporary era, there are four recognized types of definitions: dictionary, legal, terminological, and scientific. The purpose of a dictionary definition is to acquaint individuals unfamiliar with a term by providing its lexical meaning (Walton 2001). Legal definitions play a crucial role in the process of legal decision-making, but there are suggestions that legal systems should also incorporate "definitional reasoning," which involves identifying, evaluating, and comparing competing interests (Aleinikoff 1987). Terminological definitions are applicable only to pure terms, reflecting the concept's notion and describing the relevant properties of the term (Halpern 2014). Scientists aim to comprehend the nature of existing entities and their behaviors. They do so in order to articulate how things behave in statements of causal laws and to capture the true essence of things in accurate definitions (Bhaskar 2015). As Rickert explains, "definition is then a means to a scientific end" (Rickert 2000, 201). It is important to note that all types of definitions must be appropriate for the context in which they are employed; therefore, they cannot be considered static "truths." Over time, meanings evolve due to technological advancements, shifting social norms, and changes in word usage (Halpern 2014, 132).

Despite the widespread acceptance of these various forms of definitions, there remains ongoing scholarly debate surrounding definitions, resulting in a multitude of defining methods, types, and theories. Moreover, the extensive criticism of one stream of thought from the perspective of another significantly influences the acceptability of definitions. Consequently, it has become a prevailing theme among authors to acknowledge that definitions are subject to convention. In line with this notion, Kuhn (1996) emphasizes that definitions serve a functional purpose due to conventional convenience, a viewpoint that aligns with Quine's essay on "truth by convention" (Quine 1997). However, it is important to note that not all conventions are inherently true; rather, they are considered true only among those who adhere to the convention (Harman 1999). Therefore, as Schiappa (2003, 3) asserts, "the distinction between accepted and utilized definitions and those that are not lies in the realm of persuasion." The persuasive power of a definition is influenced by various factors, including the reputation of the individual proposing the definition and whether the definitions are endorsed by authoritative figures who provide standard definitions.

According to Pearson (1998), the act of defining can be approached in two distinct manners. Firstly, defining can occur when a definition is initially formulated and expressed, which is known as defining exercitives. The term exercitives is defined by Austin (1975, p. 154) as " the giving of a decision in favor of or against a certain course of action, or advocacy of it. It is a decision that something is to be so" Secondly, defining can take place when a definition is restated or rephrased in order to provide clarification or explanation, referred to as defining expositive. The term expositive is defined by Austin (1975, p. 160) as "the expounding of views, the conducting of arguments, and the clarifying of usage and of references."

Definition exercitives are commonly observed when experts write for their peers or when a term already exists within a specific field of study, but the author intends to assign it a new meaning, particularly within academic literature. This process can be undertaken by an individual or a group of individuals, known as individual-level defining exercitives. Alternatively, it can be carried out by an authoritative body such as a standardizing organization or professional association, referred to as consensual defining exercitives.

In the former scenario, the level of conventionality is determined by the author's reputation and the publication in which the definition is presented. Conversely, in consensual definition exercitives, the degree of conventionality and persuasiveness is higher. The heightened degree of persuasiveness can be attributed to the longstanding credibility of the standard-setting bodies, which have been diligently formulating standardized terminologies for numerous decades.

In the field of information systems, approaches to defining are employed like other academic disciplines. To this end, dictionaries such as Downing (2009) and encyclopedic publications like Bidgoli (2003), Henderson (2009), and Khosrow-Pour (2005) serve as reference sources for definitions of terminology used in the subject of study. These works are the result of a collaborative effort between academics and organizations that have recognized the need for such publications to promote a shared understanding among users of the terms contained therein. Such publications can be considered as examples of individual-level defining exercitives. Conversely, publications issued by the International Organization for Standardization (ISO) and IEEE Standard terminologies can be cited as examples of consensual defining exercitives. Both individual and consensual levels of defining rely on sources such as conference proceedings, books, and journal publications, in addition to the individual or organizations own definitions.

In spite of the extensive endeavors made to establish precise definitions for terms within the field of information systems, a considerable number of terms remain undefined due to various factors. One such factor is the insufficient expertise of professionals in defining terms, stemming from their limited understanding of communication and logic principles (Parnas 1990). Consequently, this article adopts a logical approach to define the concept of blockchain. To achieve this objective, a comprehensive collection of academic publications was procured from multiple databases, which were subsequently subjected to analysis using WordStat, a software specifically designed for quantitative data analysis. Based on the findings, a tentative definition of blockchain is proposed.

Academic publications present definitions in various formats. However, for those definitions with a genus difference form, a semiautomated approach was employed to extract them from the publications. This approach involved combining WordStat searching and manual screening. The extraction process involved using the phrase "blockchain is," which yielded both definitions and non-definitions that included the phrase. Subsequently, the non-definitions were eliminated, resulting in a mini-corpus of definitions.

To analyze the corpus and identify the essential distinguishing characteristics of blockchain, we followed Rickert assertion that definitions must specify the essential characteristics of objects and utilize them in the formation of concepts (2000, 216). Furthermore, in accordance with the Correspondence Theory of Truth, as expounded by Newman (2002), class words that do not correspond to facts were rejected. Conversely, the class word that accurately corresponds to the fact was accepted for use in defining blockchain.

Definitions play a crucial role in shaping social knowledge and fostering a shared understanding among individuals regarding the nature of things and their existence in reality. They also guide the appropriate use of language (Schiappa 2003). Moreover, definitions serve as the foundation for the development of theories in all academic disciplines (MacKenzie 2003). Consequently, the consistency and coherence of theories within a particular field are heavily influenced by the definitions of the terminology employed in that domain. Larsen and Bong (2016) highlight that the lack of uniformity in defining terms raises several issues, including construct identity fallacy (CIF). CIF manifests in two forms: the jingle fallacy, where two constructs with similar names refer to distinct real-world phenomena, and the jangle fallacy, where different construct names are used to describe the same real-world phenomenon.

In the realm of IS, the absence of precise definitions has impeded the establishment of a cumulative tradition where scholars can expand on one another's research and exchange ideas and themes. For instance, the ambiguity in defining the fundamental concept of the field "information" highlights the lack of agreement on what IS truly encompasses, resulting in a negative effect on its theoretical foundation (Keen 1980). Similar to all areas of IS, there has been a prevalent occurrence of fallacies in connection with blockchain for a considerable period. Specifically, many scholars mistakenly believe that blockchain, bitcoin, and cryptocurrency are interchangeable terms. Swan (2015) emphasizes that the terms Bitcoin and blockchain can refer to any of the three fundamental elements of the concept, including the foundational blockchain technology, the protocol and client used for transactions, and the tangible cryptocurrency. Alternatively, these terms can be used broadly to encompass the entire concept of cryptocurrencies. Du et al. (2019) have extensively deliberated on this matter and have elucidated that it has negatively affected the acceptance and adoption of this technology.

Moreover, the prevalence of confusion surrounding blockchain technology has a significant impact on user perception, particularly in terms of its usefulness, risks, and benefits. As such, it is imperative to provide a clear and concise definition of blockchain, despite the inherent challenges in doing so. It has been observed that various authors have differing interpretations of blockchain, with some considering it a database, others a data structure, and still others a transaction management technology. However, it is important to note that these interpretations are not entirely accurate. Therefore, as the essentialist school of thought posits, a precise definition is necessary to convey more exact and certain information than can be achieved through descriptive statements (Abelson 2006).

Blockchain is a technology of great importance due to its paradigmatic nature. Defining it is significant for several reasons including:

1. Definitions serve as the foundation for theory formulation (MacKenzie 2003), and as such, defining blockchain facilitates the development of theories.
2. The absence of a clear definition can have a detrimental impact on the adoption of a technology (Du et al. 2019). Defining blockchain can enhance its adoption, thereby promoting its widespread use.
3. Defining a term fosters the prevalence of cumulative tradition, where knowledge accumulates rather than being piled up (Keen 1980). Defining blockchain is essential for fostering a shared understanding and promoting knowledge advancement.
4. Defining blockchain helps to avoid the occurrence of construct identity fallacy (CIF) (Larsen and Bong 2016). As a result, clear distinction between Bitcoin blockchain and cryptocurrency etc. can be made so that inappropriate use of these terms will be avoided.
5. It is important to note that nothing useful can be said or known about a concept until it is properly defined (Kaplan and Haenlein 2006).

However, the definition presented herein is tentative owing to the lack of a widely accepted "definition in use" (Carnap 2003) for the class term employed to define blockchain, as well as the continuous evolution of the technology, which may render presently deemed essential characteristics insignificant in the near future.

The article is structured as follows: it begins with an introduction, followed by a section discussing the relationship between language and information systems and the important aspects of blockchain. A literature review is then conducted, focusing on different types and methods of definitions. The article then explains the method used to prepare it and moves on to a discussion section outlining the reasons for rejecting specific genus terms and differentiae, as well as the proposed definition. Finally, the main sections of the paper conclude with a summary and the analyzed definitions, a list of terms used in the definitions, and a concordance table for some key terms are included as an annex at the end.

2.0 Background

This section presents background information on the relationship between language and information systems and a comprehensive background on blockchain.

2.1 Language in information systems research

Scholars in the field of information systems analyze the connections between language and information systems from various viewpoints and levels of abstraction. While some consider language to be the central focus of the discipline, others view it as a fundamental component. In the former sense, scholars emphasize that communication serves as the foundation of information systems. For example, Lyytinen (1985) highlights how the primary purpose of an information system is to facilitate human communication and argues that an information system would be meaningless without a linguistic function. On the other hand, authors such as Orlikowski and Iacono (2001) perceive the primary subject of information system research to be the information systems artifact, which encompasses four components: constructs, models, methods, and instantiation. In this perspective, language is represented by construct, which serves as the fundamental language for presenting concepts.

For those who consider communication as the primary focus of the discipline, language theories are essential as they can be utilized to interpret existing design approaches to information systems. These theories emphasize the importance of selecting an appropriate perspective in designing an information system (Lyytinen 1985). A language action viewpoint, which regards the use of information systems as a form of communicative action, is consistent with this perspective (Lyytinen, 1987). According to this viewpoint, design is considered an ontological process encompassing more than just the design of structure and function. It involves participating in the organization and design of practices, which includes designing the work rather than the tool. This can be effectively achieved by using appropriate language to describe the process (Winograd 1986).

The second group of scholars views information systems artifacts as the central focus of an information system, with language being just one component of these artifacts. Accordingly, information systems artifact encompasses four elements: constructs, models, methods, and instantiation. Constructs represent a basic language for concept presentation with which it is possible to characterize phenomena. Models on the other hand are higher-order constructions used to describe tasks, situations, or artifacts. The ways of performing goal-directed activities are presented through methods. These all are instantiated in specific products and physical implementations intended to perform certain tasks (March and Smith,1995).

Both groups of literature stress the importance of utilizing appropriate language when designing information systems. The group that focuses on artifacts is the dominant force in information system research, conducting research that ranges from conceptualizing to theorizing artifacts. However, it has long been recognized that concepts in information systems are often presented in an imprecise manner due to professionals' lack of knowledge in defining them, stemming from their unfamiliarity with communication and logic principles (Parnas 1990).

Over time, various fields of study related to information systems have emerged to address it. One such field is artificial intelligence, which tackles the issue through its three subfields: natural language processing (NLP), machine learning, and knowledge representation (Vargas et al. 2018). NLP, also known as computational linguistics (Bolshakov and Gelbukh 2004), focuses on developing information systems that can process words in natural language texts. Its foundation is built on computer and information sciences, languages, mathematics, psychology, and other disciplines. NLP is used in a wide range of research fields, including machine translation, natural language text processing and summarization, user interfaces, multilingual and cross-linguistic information retrieval (CLIR), and other areas of study (Chowdhary 2020).

Machine learning is a field of study that aims to develop methods for computers to learn by detecting statistical regularities or other data patterns. This is achieved through the use of algorithms that mimic the human approach to task learning (Nasteski 2017). Machine learning has become the preferred method for creating useful systems in various applications such as computer vision, speech recognition, natural language processing, robot control, and more. As machine-learning approaches for analyzing high throughput experimental data have been developed, there have been significant consequences throughout empirical sciences, from biology to cosmology to social science (Jordan and Mitchell, 2015).

Machine learning algorithms are generally classified into two types: supervised and unsupervised approaches

(Nasteski 2017). Muhammad and Yan (2015) conducted a survey about supervised machine learning algorithms, while Usama et al. (2019) conducted a survey about unsupervised machine learning approaches.

Knowledge Representation is a field within Artificial Intelligence that deals with the symbolic representation and manipulation of knowledge by automated reasoning systems (Brachman and Levesque, 2004). The focus of research in this area is typically on either the formalism used for representation or the information that is encoded within it, which is known as knowledge engineering. Formalisms for representing knowledge require a well-defined syntax, meaningful semantics, and a computationally traceable inference mechanism (Hayes 1999). Syntax establishes a set of rules, while semantics describes how expressions are understood.

To be effective, a representation must meet certain desirable requirements, including metaphysical adequacy (no contradiction between facts), epistemic adequacy (the ability to communicate facts), heuristic adequacy (the ability to describe the thinking process), and computational traceability (the ability to manipulate the representation within a system) (Bench-Capon 1990). Examples of knowledge representation systems include knowledge graphs (Nickel et al. 2016), which model information in the form of entities and their interactions, as well as frame-based graphs (Minsky 1988). Natural language is also a tool for knowledge representation (Bench-Capon 1990). These three topics are pertinent to this study from a methodology perspective, and their application is described in the methodology section.

2.2 Blockchain

The genesis of blockchain invention is contentious. Numerous authors (Abe et al. 2018; Conoscenti et al. 2016; Ehmke et al. 2018; Feng et al. 2019; Liu et al. 2017; Novo 2018; Pazaitis et al. 2017; Pinno et al. 2017; Qu et al. 2018; Reyna et al. 2018) attribute Satoshi Nakamoto, the creator of Bitcoin, as the inventor of blockchain, or they claim that blockchain was first used by Bitcoin. On the other hand, others argue that the components of blockchain technology existed before the launch of Bitcoin.

According to Wood (2019), Dwork and Naor (1993) designed proof-of-work for spam detection, which is currently employed by Bitcoin as a consensus mechanism. Furthermore, before Bitcoin came into existence, Vishnumurthy et al. (2003) used proof-of-work for trading files in a peer-to-peer network. Consistently, authors, including Aste et al. (2017) and Wang et al. (2019), describe that the only invention that Bitcoin has brought is operationalizing a monetary system without the involvement of a central organ.

Furthermore, Dhillon et al. (2018) stress Bitcoin's Byzantine fault tolerance capability as its major contribution, but Lamport et al. (1982) introduced the foundation idea years before Bitcoin came into life. Byzantine fault tolerance denotes the unfettered functionality of a network despite some members acting dishonestly.

Blockchain has ample potential to transform human activities and the relationships between mankind. Its superior value is emphasized by authors such as Efanov and Roschin (2018), who regard it as the most significant invention since the dawn of the Internet. Similarly, Swan (2015) labels it "the fifth disruptive computing paradigm." However, Iansiti and Lakhani (2017) agree with its bearing but argue that it will take decades for it to be disruptive. Compared to the Internet, which is presented as the third disruptive paradigm in Swan (2015), it is explained by Saberi et al. (2019) that blockchain can transfer value that outstrips the ability of the Internet by which information has been transferred. This improvement results from various computer and economic principles, most notably peer-to-peer networks, asymmetric cryptography, consensus protocols, decentralized storage, decentralized computation, smart contracts, and incentive systems (Eberhardt and Tai 2017). The evolution of each computing and economics concept concerning their use in blockchain has been developing.

The development of blockchain technology has had a significant impact, continuously evolving its potential to transform various aspects of human activities and relationships. The introduction of Bitcoin has greatly accelerated blockchain research, leading to extensive advancements in the field. Similarly, subsequent platforms developed after Bitcoin have significantly impacted the progress of blockchain, each making substantial contributions in various ways.

Initially, blockchain was primarily used for cryptocurrency when Bitcoin was introduced. However, the entry of Ethereum revived the concept of smart contracts proposed by Nick Szabo (Szabo 1997). Ethereum expanded the capabilities of blockchain technology by incorporating smart contracts, enabling the management of content rights, administration of smart property, and reputation-based credit management. This expansion paved the way for a broader application of blockchain, leading to the classification of blockchain usage for cryptocurrency as blockchain 1.0, and blockchain employment with smart contracts as blockchain 2.0. Subsequently, the introduction of various platforms further expanded the use of blockchain, resulting in the emergence of blockchain 3.0. This new phase of blockchain technology has found applications in healthcare, industry, supply chain management, and other sectors (Swan 2015).

Despite the advancements in the field, there is still a lack of clarity among various stakeholders regarding the distinction between Bitcoin, cryptocurrency and blockchain. This confusion arises from the significant impact that Bitcoin has had on the development of blockchain technology. In their study, Du et al. (2019) argue for the separation of blockchain from Bitcoin, emphasizing that these two concepts are distinct. The confusion stems from the fact that blockchain is utilized to track transactions in Bitcoin. Moreover, the adoption of blockchain technology has witnessed a substantial increase following the introduction of Bitcoin. However, despite the growing interest in blockchain research, there remains a lack of consensus on the terminology associated with this technology. Multiple definitions of blockchain exist, which can impact the accurate comprehension of this technology, as emphasized by Adere (2022). Consequently, this article critically examines the existing literature aiming to provide definitions of blockchain.

3.0 Literature review

In the current setting, four definition traditions have been deemed to be acceptable: scientific, legal, dictionary, and terminological. Because each of these streams contains flaws of its own, it is common to criticize one from the standpoint of the other, indicating a lack of consistency and competitiveness (Rey 2000). For a long time, there has been inconsistency and divergence in opinions, which includes, among other things, theories formulated on definition, definition's purpose, categorization of definitions, and the methods used in developing definitions. Regarding theories of definition, Rickert explains that "There are no two modern logicians with the same theory about definitions" (Rickert 2000, 199). This implies that scholars argue on anything from whether definition is necessary to whether definition exists at all (Fodor 1998).

Several of the disagreements between authors are intractable (Schiappa 2003). Some writers depict how challenging or impossible it is to define some concepts. Wittgenstein (1968), for example, shows why it is impossible to define "game", and Fodor (1981) illustrates how vague a definition of paint would be if it were to exist. Despite these kinds of issues, definitions have supporters; their contributions are discussed in the coming sections of this part. Generally, it has to be noted that "disagreement is not disconfirming, it is as much a datum for philosophizing as agreement is" (Cavell 1976, 95). Therefore, authors of the past and present propose varying definition types, methods to be followed, and theories that deal with definition.

However, in what might be viewed as a great attempt to comprehend this incomprehensible issue, Abelson (2006) divides viewpoints on definitions into three main categories: essentialist, prescriptive, and linguistic, depending on their objectives and substance. According to essentialists, the objective of definitions is to give descriptive knowledge gathered by a consistent cognitive mode known as intellectual vision, intuition, reflection, or conceptual analysis. For prescriptive thinkers, definitions are symbolic conventions that strive to eliminate ambiguity and vagueness through syntactic and semantic rules. This stream is divided into two basic types: normalist and formalist. The former describes definitions as semantic rules for assigning names to objects, while the latter is concerned with syntactic rules for abbreviating strings of symbols to clear up or avoid ambiguity, vagueness, and obscure language rather than communicate information. From a linguistic standpoint, definitions are reports of language behavior that provide descriptive knowledge of how to use words correctly.

3.1 Definition types

Scholarly literature from both historical and contemporary periods endeavors to classify definitions. Aristotle classified definitions into two types: real and nominal, while Kant categorized them as analytical and synthetic (Abelson 2006). Additionally, Russell proposed a classification of definitions based on intension and extension (Russell 1908; Whitehead and Russell 2011), which was further elaborated by Carnap (2003). These classifications have laid the groundwork for modern literature on definitions.

For instance, Riemer (2010) builds upon Aristotle's categorization by further dividing the nominal category into cognitive, which aims to convey knowledge about the proper usage of a word, and extensional, which seeks to narrow down the meaning of a word. Similarly, Hurley (2015) adopts Carnap's well-known intensional and extensional categorization as the basis for grouping definitions. A summary of various classification types of definitions can be found in Table 1.

The definition types listed in Table 1 share certain similarities and differ from one another in some ways. However, the ones described in Flowerdew (1992) are used to categorize the definitions. The major element of this classification is the distinction between formal and semi-formal definitions, with the difference between the two being the inclusion of a class term in formal definitions and its absence in semi-formal definitions. As a result, formal definitions are the same as the Aristotelian definition, which presents definitions according to genus and difference. This definition type is further divided into four categories: location/occurrence, composition/structure, behavior/process/function, and attribute/property. The behavior/process/function definition type explains how an object acts and reacts, the operations it can execute, and the reason for which the object to be defined is utilized. On the other hand, the composition/structure definition attempts to show what the term to be defined is comprised of and what form it exists in. The location/occurrence definition, on the other hand, attempts to portray the location where the term to be defined processes its actions and exists. Finally, the attribute/property definition concentrates on the object's unique qualities

Author	Definition Type	Explanation
(Hurley 2015)	Extensional (Denotative)	Assigns meaning to a term
	1 –Demonstrative (Ostensive)	Definition by pointing at the object
	2 – Enumerative	Naming the members of the class the term denotes
	3 - By subclass	Naming subclasses of the class denoted by the term
	Intensional (connotative)	Indicates the qualities or attributes that the word connotes
	1 – Synonymous	Using a single word that connotes the same attribute
	2 - Etymological	By disclosing the word's ancestry both in its language and other languages
	3 - Operational	Specifying certain experimental procedures that determine whether or not the word applies to a certain thing
	4 - By genus and difference	Identifying a genus term and one or more difference words
(Riemer 2010)	Real	Describing the essence or inherent nature of a thing
	Nominal	Describing the meaning of the word that denotes the thing
	1 – Extensional	Fixing the meaning of a word to avoid ambiguity
	2 - Cognitive	Explaining to someone who does not already understand it
(Munson and Black 2010)	Reportive	Explains how a word is actually used
	1 – Lexical	How a word is used in ordinary life
	2 – Disciplinary	How a word is used in some special area (technical use)
	3 - Historical	How a word was used in the past
	Stipulative	Explains how a word is going to be used
	1 - Arbitrary	How the writer or speaker has decided to use a word
	2 - Precising	How the writer or speaker is going to restrict the meaning of an ordinary word to make it more exact
(Flowerdew 1992)	Formal	Explained below
	1. Behavior/process/function	
	2. Composition/structure	
	3. Location/occurrence	
	4. Attribute/property	
	Semi-formal	
	1. Behavior/process/function	
	2. Composition/structure	
	3. Location/occurrence	
	4. Attribute/property	
	Substitution	
	1. Synonym	Employing a word that implies the word to be defined
	2. Paraphrase	Using different words to explain a phrase or a sentence differently
	3. Derivation	Using words that are obtained from the original word
	Ostensive	Showing through pointing at objects

Table 1. Some examples of types of definitions

in comparison to others in the same class without mentioning the other three defining subcategories stated here.

3.2 Methods of defining

There exist various approaches to defining a concept, ranging from the use of demonstrative gestures to identify the object in question, which may not be applicable to abstract concepts, to more sophisticated techniques. Presented below are some of the methods employed. While some scholars consider defining through the aforementioned methods as a distinct approach, others perceive definition types and methods in a distinct manner.

Hurley (2015) can be considered an example of those who offer similar definition types and methods, as he states the definition types are methods as well. In contrast, after delivering definition types discussed above, Munson and Black (2010) distinguish between the two by providing definition techniques such as synonym, genus and spices, ostention, example, and complete enumeration. The synonym definition approach involves offering a term or phrase that is equivalent or nearly identical in meaning to the word defined. Genus and species, on the other hand, refer to the class to which a term belongs and describe its unique characteristics within that class. The simplest technique of definition is ostention, which uses pointing to the object to be defined. An example method of definition accomplishes definition by providing instances of the kind of objects the term designates. Finally, the complete enumeration approach entails listing all of the items that the term indicates.

The genus difference technique, as described in Hurley (2015), is considered applicable for constructing all types of definitions. Although commonly referred to as the Aristotelian method, it is important to note that Aristotle's definition writings encompass a wide range of theories, making it misleading to attribute a single "Aristotelian" definition theory. Additionally, the Socratic and Platonic defining approaches have also contributed to the development of this methodology. However, Aristotle structured it with the formula X is a Y, along with additional distinguishing characteristics (Schiappa 2003). Consequently, a definition in this method consists of the term to be defined, known as the *definiendum*, and the *definiens*, which includes a term that classifies the *definiendum* and provides further information about its qualities.

In terms of sentence structure, the *definiendum* is positioned on the left side of the sentence, while the definiens is on the right (Flowerdew 1992). Various authors use different terms to refer to the component of the definiens that performs classification, such as superordinate (Meyer 2001), class word (Munson and Black 2010), and genus term (Flowerdew 1992). Similarly, different authors use different titles to describe the qualities that illustrate the *definiens*, such as distinguishing characteristics (Meyer 2001), species (Munson and Black, 2010), and differentia (Ross et al. 2004). For the purposes of this paper, these terms are used interchangeably.

The method has been used for millennia with almost no changes (Abelson 2006). Aristotle suggests definition to be performed by division and generalization (Deslauriers 2007; Ross et al. 2004). The use of these techniques implies the existence of a hierarchy between the object to be defined and the class to which it belongs, which brings us to the notion of Russell's (Russell 1908) theory of types, as elaborated by Whitehead and Russell's (2011), who establishes the existence of a logical types hierarchy in which a class cannot be a member of itself, nor can one of its members be the class. In this paper, blockchain is defined using this method. The comprehensive procedure that Aristotle describes includes the methodology's specifics as well. According to Abelson (2006, 674):

1. A definition should give the essence or nature of the thing defined, rather than its accidental properties
2. A definition should give the genus and differentia of the thing defined
3. One should not define by synonyms
4. A definition should be concise
5. One should not define by metaphors.
6. One should not define by negative terms or by correlative terms.

4.0 Methodology

This paper has been prepared using a rigorous three-step procedure, which can be summarized as follows. Firstly, a comprehensive search was conducted across several reputable databases, including Sciencedirect, Springer link, INFORMS, Sage, Taylor and Francis, Emeralds Insight, IEEE Xplore, and JSTOR, using the key term "blockchain". This search yielded a total of 6,852 documents. Secondly, 674 grey publications, such as reports, theses, dissertations, and monographs, were excluded from the analysis. Finally, from the remaining 6,178 publications, definitions of "blockchain" were extracted using semi-automated method. This method returned 102 definitions, of which 41 were identified as duplicates and removed. The remaining 61 definitions were then used to create a corpus of definitions for further analysis. Figure 1 provides a summary of these processes.

4.1 Corpora and Definition extraction

A corpus is " a systematic collection of texts, which documents the usage features of a language or language variety" (Hartmann and James 2002, 30). Corpora are actual text, thus it is possible to use them to discover what people express and do not express as well as how frequently they do so. Additionally, they can be used to test theories or undertake new research. Furthermore, corpora can be a helpful supplement to other sorts of resources, including dictionaries, printed texts, subject matter experts, and intuition, since they have advantages over them (Bowker and Pearson 2002).

There are several types of corpora, including reference corpora, which contain a language's standard vocabulary, special purpose corpora created for a specific research purpose, monitor corpora designed to track language evolution, and parallel corpora or translation corpora, which contain original texts as well as translations into another language (Teubert and Cermakova 2004). Special purpose corpora can be developed for a variety of purposes and texts ranging from a specific subject area textbook to informal conversation, from a certain topic to a variety of languages. It can be designed by considering the corpora's purpose,

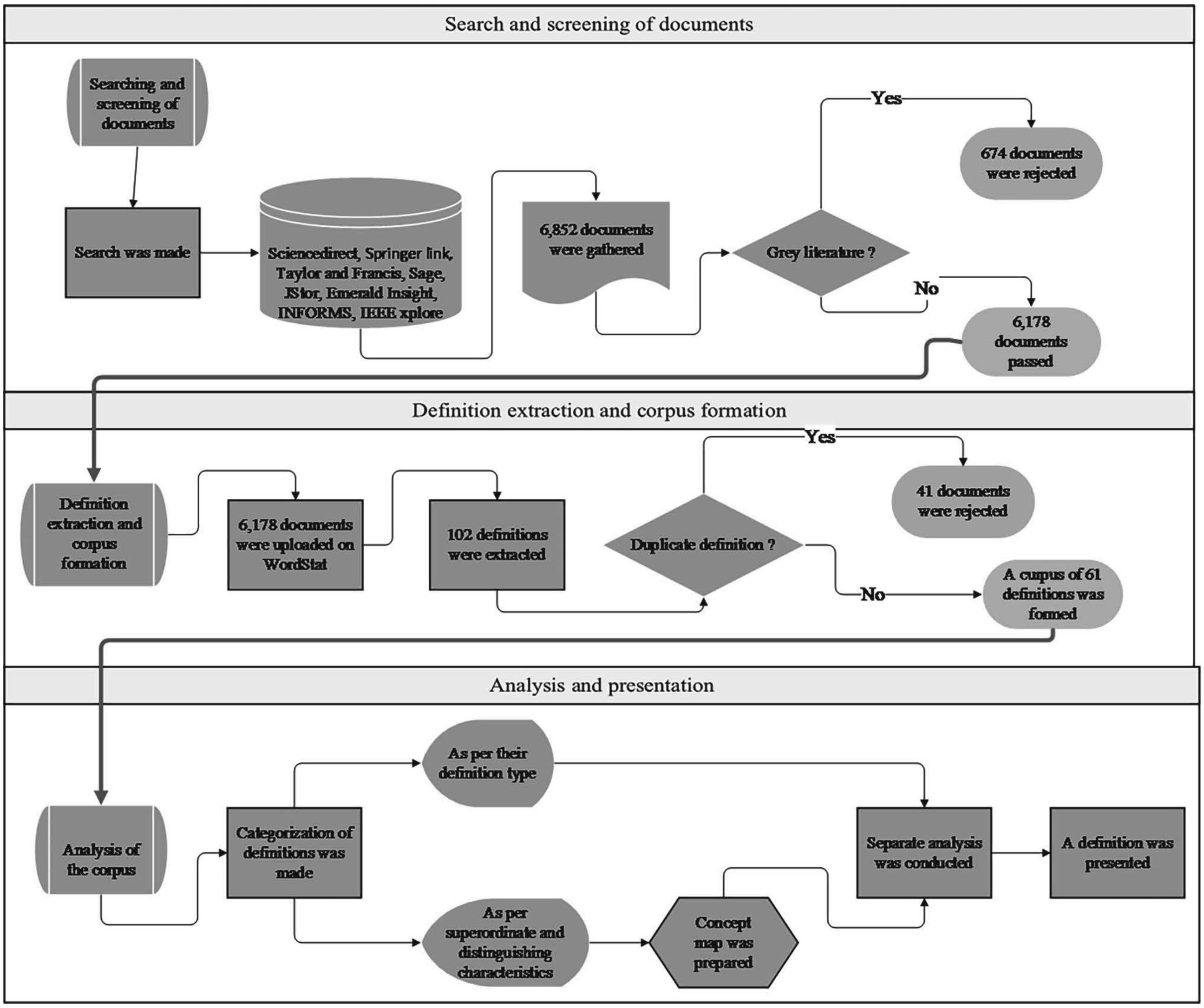

Figure 1. Workflow of the methodology

genre, representativeness, and applicability. The extent and technique of data collection, however, are determined by the genre under discussion (Flowerdew 2004).

Despite its numerous advantages, there are concerns with using corpora such as authenticity, representativeness, sampling (Tognini-Bonelli 2001), and applicability (Flowerdew 2004). In some cases, these concerns are not handled correctly, resulting in inaccurate outcomes. As a result, when employing corpora, care must be taken to avoid the development of such circumstances. By taking into account these issues, authors employ corpora for various research, including for works that are somehow related to this paper. For instance, Flowerdew (1992) employed a corpus containing a large number of definitions of terms to analyze the frequency, distribution, form, and function of definitions. Similarly, the corpus in Westerhout (2009a) is made up of a vast number of definitions. In these publications, definition extraction—the process of obtaining definitions from their sources—is generally used.

Definition extraction is "the excerption of terminological data from a corpus" (Hartmann and James 2002, 141). It is used for various purposes, including question answering (QA), dictionary building, ontology development, and glossary creation (Westerhout 2010). There are two techniques for definition extraction: rule-based and machine learning-based (Westerhout 2009b, 2010). The methods can be used independently or in combination to achieve a better result. The rule-based definition extraction method presupposes the presence of patterns in the definition of concepts. These patterns are characterized as lexical, grammatical, or paralinguistic (Meyer 2001). In this article, we employ lexical patterns, which is the most common pattern type. Lexical patterns involve one or more distinct lexical elements. For example, hyperonymy patterns incorporate "is a", "classified as", and "defined as"; meronymy patterns take in "its", "is a portion of", and "contains"; and function patterns include "required for", "serve as", and "designed for" (Meyer 2001).

In this article, the genus and difference type of definition or hyperonymy were extracted using the "is a" pattern recognition approach, which means that to fetch the definitions, we used the search phrase "blockchain is" on the software WordStat. The software is a quantitative data analysis tool for determining correlations between words, phrases, or categories of words and other numeric or categorical variables found in documents (Provalis Research 2021). The search yielded 1,872 sentences containing "blockchain is", which included both definitional and non-definitional. The definitions were selected manually from among them. The portion of the screenshot of the software is presented in Figure 2.

4.2 Analysis of the definitions

The analysis was performed semi-automatically, which means that the software was used to identify the locations where definitions were presented as well as the frequency with which definitions and key terms were presented in the publications. Other activities, such as definition selection, were done manually. Accordingly, in the manual selection process, 102 definitions were found. Those that relied on definitions made by other authors and presented in them through citations were omitted. This resulted in a reduction of the number of definitions to 61. Afterward, the definitions are categorized by their superordinate term. Furthermore, they were also grouped per the formal definition type presented in Flowerdew (1992). The result of the analysis is presented in the findings section.

The definitions were mapped using a concept map built in WordStat to demonstrate the concurrence of key terms. Concept maps have been an information visualization method numerous scholars have used for decades. According to Lune and Berg (2017), it was initially used by Joseph D. Novak's Cornell University research program. Though it was originally employed to examine changes in students' knowledge of science topics, it has since been applied to other issues, such as instructional design, and to understand changes in meanings (Novak 1990). Additionally, researchers have demonstrated the several applications for which a concept map may be used, including as a research tool for creating an illustrative representation of ideas or plans and their relationships (Lune and Berg 2017), can be used as a starting point for developing an ontology for a knowledge management application (Starr and Parente de Oliveira 2013), in marketing used to identify brand association networks (John et al. 2006), and to show the impact of transportation projects on environment and community health (Balal and Cheu 2019), and so on.

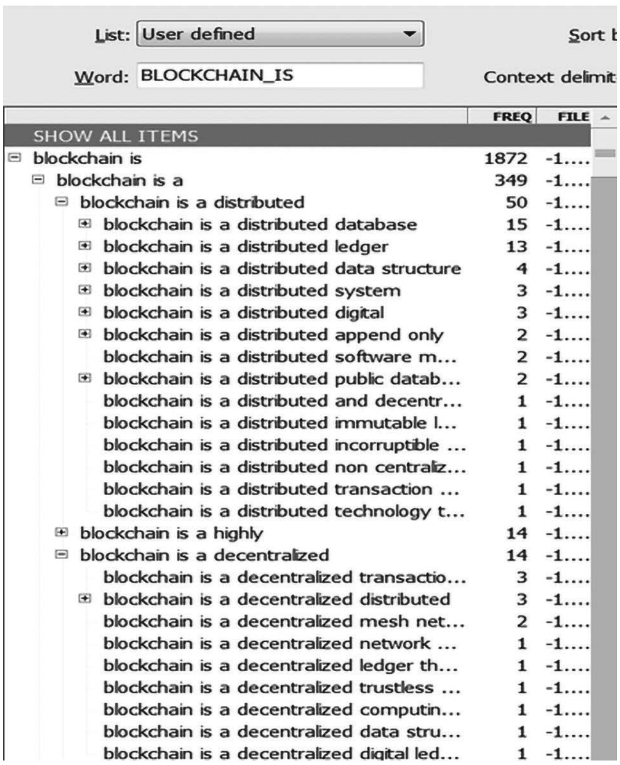

Figure 2. Screenshot of the definition extraction process of WordStat

The software's concept map utilizes multidimensional scaling (MDS) to visually represent the proximity values of keywords. Each point on the map corresponds to a keyword or content category, with the distances between points reflecting the likelihood of their co-occurrence. Proximity on the map indicates a tendency for items to appear together, while greater distances suggest independence or lack of co-occurrence. Furthermore, the map employs colors to denote the membership of items in distinct partitions formed by hierarchical clustering (Provalis Research 2021, 200).

4.3 Definition development

The definition analysis shows that there is a legitimate class term and correct and wrong distinguishing characteristics. Therefore, it was decided to reject the wrong distinguishing characteristics and the incorrect class terms. The evaluation method is based on the Correspondence Theory of Truth, which states that a proposition is true if and only if it corresponds to a fact, and false if and only if it does not correspond to any fact. Newman (2002) provides a detailed discussion of the theory. The class terms and distinguishing characteristics used to define blockchain are examined in the discussion section of this article, and any that are not true are rejected.

As stated in the literature review, there are various approaches to defining. We used the Aristotelian definition technique, which suggests using a class term and distinguishing characteristics. Furthermore, definitions should be concise and show the essence or nature of the item stated rather than its accidental qualities. Moreover, synonyms, metaphors, and negative terms should not be used in the definition. As a result, these issues have been considered when defining blockchain.

5.0 Findings

The contents of the extracted definitions reveal that all the four kinds of definitions discussed in Flowerdew (1992) are prevalent. Most definitions focus on attribute/property type in which the qualitative features of blockchain, such as the distributed, immutable, secure, transparent, and auditability of transactions kept in it, are mentioned. The second most common form is the composition/structure kind of definition, whereby the constituent components of blockchain are their focus. The themes they emphasize include the components that create a block, the data structure of blockchain, and so forth.

On the other hand, those that attempt to portray the behavior/process/function of blockchain seek to cover areas such as the processes by which transactions are recorded in blocks, the chronological nature of transaction recording, and the append-only feature of blockchain. Additionally, these types of definitions include information on the domains in which blockchain can be used, the objectives for which it can be used, and the absence of intermediaries in blockchain-based systems. The final and least employed definition kind is location/occurrence. This sort emphasizes the role of peer-to-peer networks in the development of blockchain. The following graph (Figure 3) illustrates the proportions of types of definitions.

The definitions generally consist of eleven genus terms. The overwhelming majority of them view blockchain as a distributed digital ledger. To a considerable extent, the remaining definitions consider blockchain technology a distributed database, data structure, transaction management technology, and peer-to-peer network. Additionally, a few outlying definitions are presented. These regard it as new institutional technology, a shared auditable platform, a decentralized trustless protocol, an infrastructure for smart

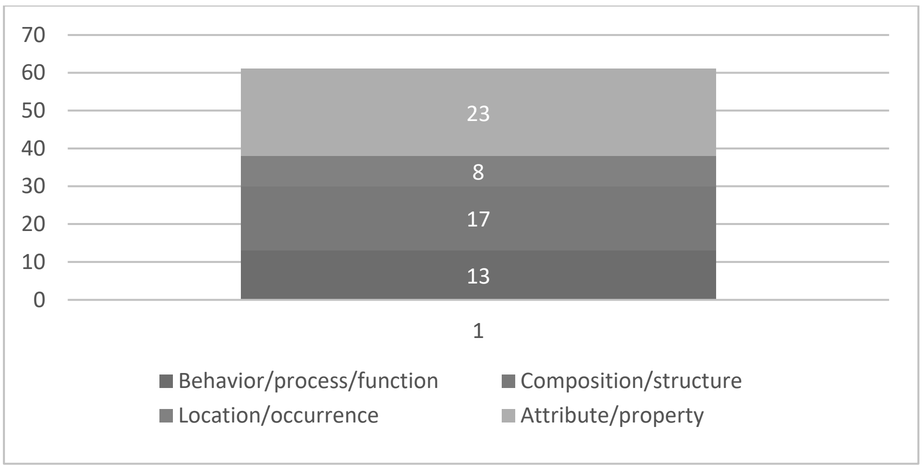

Figure 3. Classification of the publications based on their definition types of Flowerdew (1992)

contracts, and a confidence machine. Figure 4 depicts the shares of each superordinate.

Although these terms are employed as class words, in some cases some authors consider one as similar to the other. For instance, Khan and Salah (2018), Wu et al. (2017), Hammi et al. (2018), and Dotan et al. (2021) use a database ledger, implying that the database in blockchain is a ledger. In other cases, some authors, like Li et al. (2018), present blockchain as a distributed database system, but the nodes in the system are maintained by distributed ledger technology. Differently, maintaining the nodes in other definitions, such as Glaser's (2017), is left to a peer-to-peer network. Such presentations entail the existence of relegating the role of a term stated as superordinate in one definition as part of distinguishing characteristics in the other. Furthermore, it depicts the presence of some commonalities between definitions that are presented with differing class words.

Table 2 and Appendix 3 display concordance tables illustrating the qualifying terms associated with class terms. In Table 2, the authors showcase the public, decentralized, im-

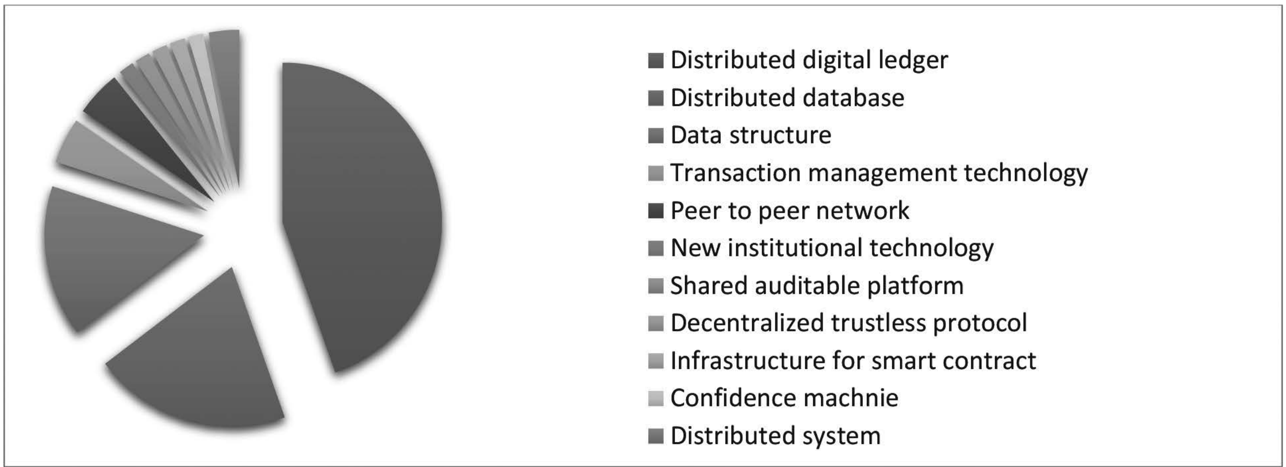

Figure 4. Share of class terms used to define blockchain

CASENO	/	KEYWORD	
1	A chain-enabled distributed	ledger	that provides tamper-resistant data storage functionality, such as tran
1	A decentralized, distributed, and public digital	ledger	that is utilized for saving the transaction in various nodes.
1	A decentralized, distributed, shared, and immutable database	ledger	that stores registry of assets and transactions across a peer-to-peer (I
1	A digital distributed	ledger	used to record and share information throughout a peer-to-peer netv
1	A digital, immutable, distributed	ledger	that chronologically records transactions in near real time.
1	A distributed	ledger	of transactions, which is structured in blocks and stored in the netwo
1	A distributed	ledger	that records and secures transactions in a peer-to-peer network.
1	A distributed	ledger	that records transactions across a network.
1	A distributed	ledger	which records information or transactions in a decentralized way.
1	A distributed	ledger	—write once and never erase
1	A distributed data structure (	ledger	), which can hold any information (transactions, records etc.) that is s
1	A distributed database (	ledger	) that maintains a permanent and tamper-proof record of transactiona
1	cords in the form of encrypted "blocks" (smaller datasets), or a public	ledger	of all transactions or digital events that have been executed and shar
1	regarded as a number of nodes jointly maintained by the Distributed	Ledger	Technology (DLT).
1	A distributed public database (	ledger	) that contains a continuously growing list of transactions which are o
1	A distributed system realizing a decentralized	ledger	or "database" with the property that once data is added, it cannot b
1	A distributed transaction/data	ledger	composed of blocks, with each block representing data linked to the
1	A list type data structure for public	ledger	which stores data elements is a block.
1	A peer-to-peer (P2P) distributed	ledger	technology based on encryption algorithms and a shared database te
1	A public	ledger	, in which all committed transactions are stored in a list (or a chain). T
1	A public	ledger	for an open and distributive community that composed of a large amo
1	A public, distributed	ledger	that contains chained blocks, each of which is made up of several trar
1	A secure distributed digital	ledger	(i.e. simultaneously shared across multiple users/locations and not stoi
1	A type of distributed	ledger	, comprised of digital records of transactions or assets, accessible to a
1	A type of distributed	ledger	in which value exchange transactions are sequentially grouped into bl
1	A unique type of computerized	ledger	, one that relies on cryptographic techniques and new methods for c
1	An append-only data structure that functions as a distributed	ledger	.
1	An encoded digital	ledger	that is stored on multiple computers in a public or private network.

Table 2.: Concordance table for the term ledger

mutable, and distributed characteristics of blockchain. The table also emphasizes the attributes of the ledger, such as the chronological recording of transactions, the tamper resistance of blockchain, the continuous growth of transaction information, and the role of peer-to-peer networks in blockchain. Additional explanations of these terms are available in the discussion section. The other key terms are presented in the Appendix, allowing for the acquisition of such explanations section.

When defining blockchain, certain terms are frequently used, with "distributed" being the most common. This term is often paired with other words like "ledger" and "database" to create genus terms like "distributed ledger" and "distributed database." Figure 5 also shows other terms that appear three or more times in definitions of blockchain. The terms are presented in their root form after conversion, such as distributed being presented as distribute.

These frequently recurring words are used to show the most prevalent distinguishing characteristics of the definitions. The widely used differentiae are used in the construction of the concept map shown in Figure 6. The concept map includes genus terms and distinguishing characteristics used in definitions, as well as connecting phrases. The concept map represent the proximity values of keywords. Each point on the map corresponds to a keyword, with the distances between points reflecting the likelihood of their co-occurrence. Proximity on the map indicates a tendency for items to appear together, while greater distances suggest independence or lack of co-occurrence. Furthermore, the colors denote the membership of items in distinct partitions formed by hierarchical clustering.

6.0 Discussion

Despite the extensive research conducted on blockchain technology, there is currently no universally accepted definition. The proposed definitions by different authors highlight a range of issues, indicating the lack of consensus in this area. This article addresses existing definitions' limitations and puts forward a tentative definition. This findings section presents a compilation of subtypes of definitions falling under the formal definition type, as outlined by Flowerdew (1992). Furthermore, the definitions are categorized based on the overarching concept they represent. The article also includes the most prevalent distinguishing characteristics and terminology used in these definitions.

Following is a discussion on the veracity of the class terms and differentiae in which the inaccurate once are eliminated so that a tentative definition of blockchain is proposed.

6.1 Blockchain and distributed database

One of the most prevalent class terms employed to define blockchain is distributed database, and this is not confined to literature. For example, prominent blockchain platforms such as Corda identify themselves as distributed databases.

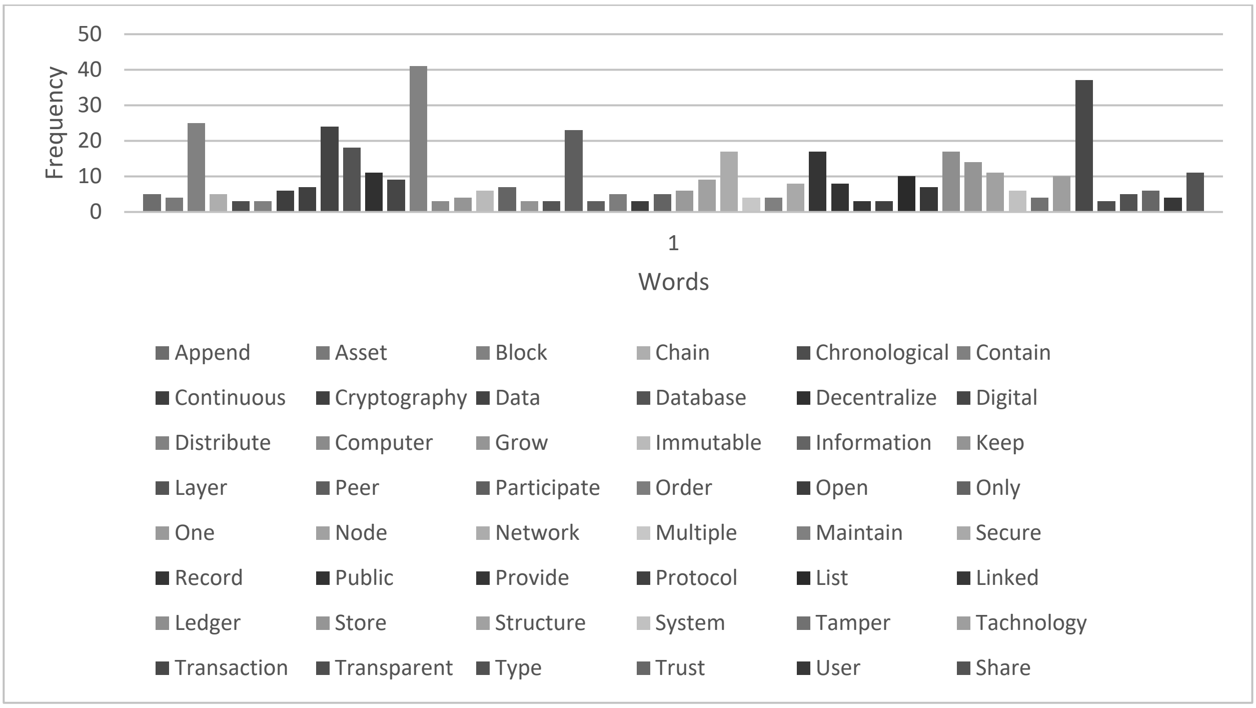

Figure 5. Words that are used three or more times in the definitions

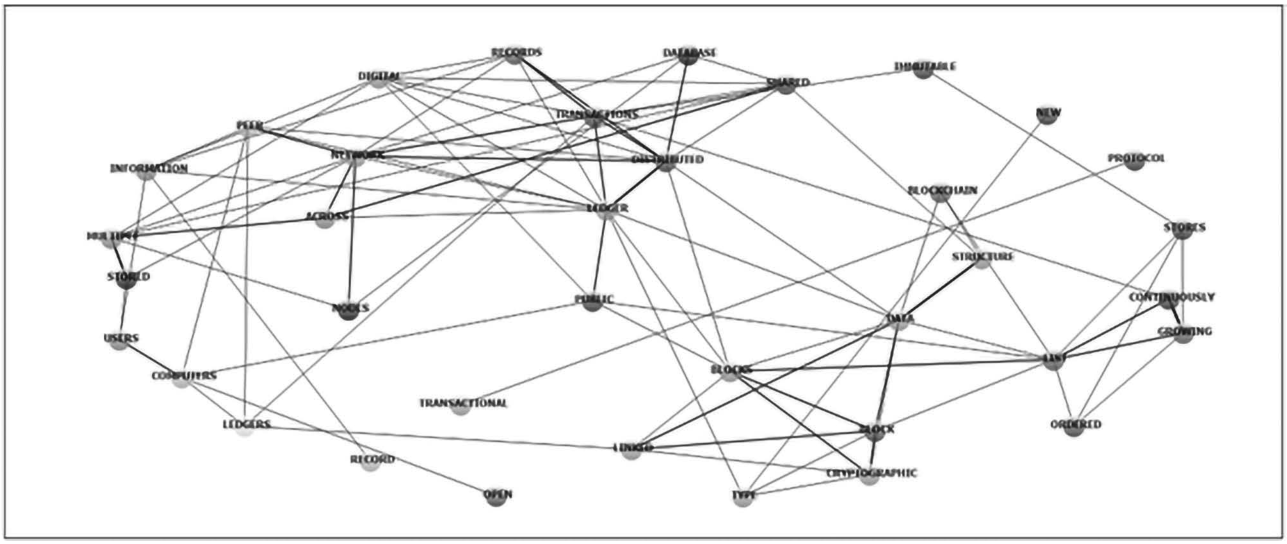

Figure 6. Concept map developed from the definitions

This is owing to some similarities between blockchain and distributed databases, such as their ability to store data in a distributed fashion. However, distributed databases are characterized by distributing processing logic or processing elements, functions, data, and control (Özsu and Valduriez 2011). These are performed with various techniques that range from fragmenting the database to replicating data. Several authors employ these issues to show the distinctions between blockchain and distributed databases.

Ruan et al. (2021) and Chowdhury et al. (2018) show the differences between the two in terms of the methods followed for replication, concurrency, storage, sharding, and data control. The presentations demonstrate that there are distinctions between the two in all issues. On the other hand, Krylov and Seleznev, (2019) argue that blockchain is not a distributed database at all as it does not store the present state of the system and does not guarantee data availability. Hence, blockchain is a chronological record of all events that have modified its state. If blockchain is considered a database, the modification in it is the deletion of the previous transaction and the creation of a new row (Peters and Panayi 2016).

Apparently, in terms of design, distributed databases and blockchain are not the same, yet they have recently shown some fusion (Ruan et al. 2021). As a result, the qualities of databases have been used to improve blockchain, while blockchain's attributes have also been employed to improve databases (Przytarski et al. 2021). Nathan et al. (2019) prove that a relational database can be upgraded with blockchain features. Similarly, it is depicted in Muzammal et al. (2019) that a blockchain database application platform called CHAINSQL is improved by leveraging distributed database features. These sorts of developments have been made by Adkins et al. (2020) and Zhu et al. (2020). A detailed summary regarding the trend in developments of the two is presented in Raikwar et al (2020).

Therefore, distributed database cannot be used as a class term to define blockchain, hence there are differences some of which are discussed above. Furthermore, it is possible to argue that blockchain has some extra quality than distributed database in that it is possible to create a transaction-specific rule in the form of smart contract (Hancock and Vaizey 2016). As a result, taking distributed database as a superordinate that includes blockchain will end up in a fallacious definition.

6.2 Blockchain and distributed ledger technology (DLT)

There is no universally acknowledged definition of distributed ledger, just as no generally recognized definition of blockchain. According to the World Bank document (Krause et al. 2017), the phrase "distributed ledger" began to emerge after the introduction of Bitcoin as an alternative model to Bitcoin's peer-to-peer money transfer method, which is named as "blockchain". However, several authors consider blockchain to be a distributed ledger, as indicated above. It is self-evident that ledgers are tied to accounting and finance, nonetheless, defining blockchain as a digital ledger technology is prevalent in a wide range of applications. Furthermore, several established platforms claim to be distributed ledgers as well.

Despite these, Rauchs et al. (2018) stress that many of the current blockchain platforms fail to meet the qualitative standards of distributed ledger technology. To be designated as distributed ledger technology, a system must satisfy five criteria. These are the quality of enabling shared record-keeping, multi-party consensus on a shared set of records, independent validation by each participant, evidence of non-consensual changes, and resistance to tampering. Nonetheless, many publications theoretically agree that blockchain is a specialized application of digital ledger technology that follows a precise data format. In this context, publications like (Allon 2018) point to blockchain as an example of DLT implementation.

As a result, although DTL is not a defined concept in and of itself, categorizing blockchain as a digital ledger technology with some distinguishing characteristics makes sense. The proposed definition in this article uses DLT as its superordinate, but defining a term with another term that does not have a definition raises concerns. This, among other things, causes me to consider the suggested definition tentative.

6.3 Blockchain and data structure

Data structure determines the specifics of how data is organized and stored (Rahimi and Haug,2010). There are several methods of data structuring, including arrays, files, linked lists, stacks, queues, trees, graphs, and so forth. In blockchain-based systems and platforms, there are two predominant data structuring strategies. They are the ones we call it in this paper the linked blocks approach and the Directed Acyclic Graph (DAG) method. While the linked blocks approach and linked list data structure have few similarities, the DAG is a graph data structure. The most prevalent blockchain data structure from these two is the linked blocks method, which involves transactions being organized in a tree format before being placed in a block. The blocks are then joined together to form a chain of blocks. In a DAG data structure, transactions represent the nodes of a graph in which block is not utilized to maintain them (Matteo Benčić and Podnar Žarko 2018).

The DAG structure started to be employed as a solution to some of the scalability and latency concerns that had been plaguing blockchain platforms. In DAG, the scalability issue is handled by requiring each transaction to validate at least two subsequent transactions. On the other hand, latency is reduced by eliminating the mining procedure (Pervez et al. 2018). Some prominent platforms, such as Bitcoin and Ethereum, use the linked blocks data structure, whilst other platforms, such as IOTA and Nano, use DAG (Pervez et al. 2018).

As demonstrated, some of the literature describes blockchain as a single data structure while ignoring the other. In this scenario, these definitions are unable to keep up with the evolution of blockchain. Furthermore, it misrepresents the fundamental characteristics of blockchain, implying that it is only just a data structure.

6.4 Blockchain and peer-to-peer network

While some authors define blockchain as a peer-to-peer network (Min 2019; Kamble et al. 2019; Xu et al. 2021), others regard peer-to-peer as a foundation on which various terms that are presented as class terms can be implemented. This means that peer-to-peer networks are used to maintain distributed databases, distributed ledgers, and data structures. Authors like Feng et al. (2019), Khan and Salah (2018), Ducas and Wilner (2017), Cheng et al. (2018), Savelyev (2018), Glaser (2017), Chen (2018), and Aditya (2020), show that a peer-to-peer network serves as a platform for maintaining a distributed database, distributed digital ledger data structure, and so on, or they are intended to serve members of a peer-to-peer network.

Furthermore, as shown by Adere (2022), the peer-to-peer network is an essential component of blockchain, thus it cannot be regarded as blockchain in and of itself. As a result, labeling blockchain a peer-to-peer network distorts its true nature.

6.5 The outlying definitions

This group includes six unique superordinates: transaction management technology, new institutional technology, a shared auditable platform, decentralized trustless protocol, smart contract infrastructure, a confidence machine, and a new software development methodology.

Those that consider blockchain in terms of transaction management have similar perspectives. Reyna et al. (2018) and Kleinaki et al. (2018) emphasize the verification process of transaction management, in which blockchain does not require a single trusted party but instead allows participants to verify transactions. Ethereum and other blockchain platforms present themselves as state transition machines that execute transactions to achieve their state transitions. However, blockchain is capable of much more than simply handling state transition processes, as demonstrated by Ethereum and other platforms. As a result, the transaction processing capability introduced by blockchain is one of its properties and cannot be used to classify it.

The confidence machine and the decentralized trustless protocol genera have a symbiotic connection. While Zhang et al. (2017) define blockchain as a trustless protocol, De Filippi et al. (2020) confirm it as a confidence machine that attempts to remove trust and restore confidence owing to flaws with trust-based systems such as interpersonal connection integrity. As a result, the two definitions share characteristics and illustrate similar characteristics from different angles, but the superordinate they employ can serve as distinguishing characteristics rather than genus.

When MacDonald et al. (2016) present it as a new institutional technology, they use new institutional economics and public choice economics as theoretical tools to show blockchain from a different perspective. They claim to characterize blockchain as a new institutional technology due to factors such as the impact of blockchain on transaction costs in the financial industry, which could have a significant bearing on the governance of financial services provision. Furthermore, the availability of smart contracts and Distributed Autonomous Organizations (DAO) allows blockchain to contribute to the formation of a self-organizing economy by introducing new contract types and organizational logic. Therefore, aside from adding a new dimension to distinguishing characteristics, this definition is incomplete.

The superordinate employed by Wong et al. (2019) is a new software development methodology. The definition of blockchain as such is the result of research that has begun to use it as a component of software development methodologies. The two primary areas in which blockchain is used for software development are global software development (GSD) and distributed agile software development (DASD) techniques. It is well known that these approaches distribute their development sites. While distributed agile software development practices face the issue of developer communication, Global Software Development (GSD) encounters issues, including continuous integration of software codes, lack of communication, control, and coordination (Niazi et al. 2016; Shrivastava and Date 2010). Therefore, employing blockchain in Distributed Agile Software Development (DASD) is predicated on the idea that it may improve collaboration, communication, security, and traceability (Farooq et al. 2022). These advantages are equally applicable in the global software development context. As a result, the link between blockchain and software development methodology is not a class and species relationship; rather, blockchain is utilized as a tool to improve the quality of software development processes, and defining blockchain as such is incorrect.

The other two definitions characterize blockchain as a shared auditable platform and infrastructure, viewing it from an infrastructure and platform standpoint. In this regard, Bocek et al. (2017) consider blockchain as an infrastructure for smart contracts, whereas Hazard et al. (2016) see blockchain as a shared, auditable platform. Digital infrastructure is defined as a shared, unbounded, heterogeneous, open, and dynamic sociotechnical system that incorporates an installed base of different information technology capabilities as well as associated user, operational, and design communities (Tilson et al. 2010). Digital platforms, on the other hand, are a collection of digital resources, such as services and information that enable external businesses and customers to collaborate to produce value (Constantinides et al. 2018).

Although not for definitional purposes, blockchain is frequently presented in publications as either infrastructure, platform, or both. For instance, Blaschke1 et al. (2019) describe blockchain as a "new infrastructure," while Constantinides et al. (2018) categorize it as both infrastructure and platform. Similarly, several publications, including Li et al. (2019), Jiang et al. (2018), Al Omar et al. (2017), and Jiang et al. (2018), see their blockchain-based prototypes and systems as platforms. Others, such as Casey et al. (2018), Glaser (2017), Lombardi et al. (2018), and Avital et al. (2016), have presented their work on recognizing blockchain as infrastructure.

As a result, viewing blockchain as a digital infrastructure and platform is conventional and is not erroneous. The problem is that infrastructure encompasses a vast number of objects and relationships made through them. For instance, the internet, data centers, open standards such as IEEE 802.11, USB, and consumer devices such as smartphones and tablets are instances of infrastructure (Constantinides et al. 2018). Similarly, Uber, Airbnb, and TaskRabbit are mentioned as peer-to-peer platforms (de Reuver et al. 2018). Therefore, using both as superordinate to define blockchain create openness and categorization problem or intension and extension issues.

6.6 The major distinguishing characteristics

There are various flawed distinguishing characteristics that authors frequently use when defining blockchain. The most common are decentralized, open, public, maintain identical replicas, and append-only, which indicate the influence of Bitcoin and other platforms that acquire traits from it. When other platforms and systems built after Bitcoin attempted to address scalability and security concerns, in addition to expanding the application domains of blockchain, these qualitative attributes were removed; hence, they were found unnecessary.

It is plausible to argue that blockchain's decentralized nature is no longer necessary given that it is used in application areas that require high privacy due to legal constraints and the nature of the application domains. The use of blockchain in healthcare can be used as an example in this regard. Because of privacy concerns in healthcare, blockchain architecture must adhere to distributed centralization; this is also true in banking and other areas that require centralization.

Similarly, employing open and public ledger as distinguishing characteristics do not recognize the presence of permissioned blockchains that are not either of the two. Permissioned blockchains have been around for years now, which require approval from an entity to utilize blockchain. As a result, referring to blockchain as such implies that the definitions are fixated on the time when blockchain was public. In blockchain identical replica is maintained is another distinguishing characteristic that is present in some of the definitions. This characteristic of blockchain was removed after Ethereum appeased users of the need to download all the blockchain data, instead of requiring them to store state information. Similarly, in Corda, transactions aren't broadcasted to all the participants of the network. Instead, it is conveyed to nodes that are involved in the specific transaction. Identically, append-only differentia that implies once anything is written, it cannot be modified aspect of blockchain has been improved to make it more flexible. In this sense, the work put forth by Corda can be used as an example. Correcting or discard transactions in Corda is possible if certain circumstances are met.

6.7 Proposing a tentative definition

The above presentation comprehensively examines the class words and most frequently used distinguishing characteristics employed in defining blockchain. It portrays the use of various genus terms, implying that blockchain signifies different things to different authors. This is partly due to considering blockchain from various perspectives by utilizing theories that can broaden the perspective from which blockchain can be viewed. The majority of incorrect superordinate, however, is owing to the existence of some artifacts that have some similarities with blockchain, such as distributed databases, and focusing on the specific characteristics such as the data structure followed in some prominent platforms. Furthermore, conflating blockchain and Bitcoin has considerably contributed to the usage of incorrect distinguishing characteristics. The critical analysis further illustrates that, for a variety of reasons, all superordinates other than distributed digital ledger technology (DLT) are rejected.

As shown above, DLT emerged as a new information system artifact as a different way to organize data and transactions for peer-to-peer asset transfer with the advent of Bitcoin (Krause et al. 2017). There are efforts to design frameworks that demonstrate its features, such as those made by Rauchs et al. (2018), who claim that DLT has five key features: shared record-keeping, multiparty consensus, tamper evidence, tamper resistance, and independent validation. All authors who define blockchain as DLT are implying that DLT is a class term that contains blockchain as its species, even though the distinguishing characteristics of blockchain used to characterize are not yet agreed upon.

Furthermore, each definition that does not use DLT as its superordinate has its differentiating characteristics, which appear to be numerous; yet, the definitions use a small number of identical differentiae, some of which are rejected as mentioned above. However, some differentiae are found in the analyzed definitions that accurately characterize blockchain, which will be utilized to define blockchain. Table 3 presents those that accurately portray blockchain by concisely summarizing the definitions.

As previously stated, these distinguishing characteristics can be used to accurately define blockchain, and the following definition is formulated using DLT as a superordinate.

Blockchain is a distributed ledger technology (DLT) that is used to autonomously record, share and keep track of a continuously growing time-ordered list of transaction information that takes place between peer-to-peer network nodes that are secured by cryptographic methods and managed by cryptographic-based consensus mechanisms, eliminating the need for third-party intermediation.

The definition contains five key distinguishing characteristics, which are:

1. Blockchain is used to autonomously record, share and keep track of transaction information
   - Since the introduction of Ethereum, smart contracts have emerged as a fundamental component of blockchain technology, allowing for the autonomous recording and tracking of transactions. Therefore, blockchain functions those tasks autonomously.
2. The transaction information is time-ordered and continuously growing
   - Regardless of the data structure used, blockchain transactions must be kept in a timestamped order; however, the "continuously growing" characteristic does not signify the endlessness of ordering. Hence, the ordering list's duration is determined by the life of the blockchain system. Bitcoin and other platforms are presumed to continue in perpetuity, however, blockchain solutions, on the other hand, can be designed for projects with a short lifespan.
3. They take place between peer-to-peer network nodes
   - A peer-to-peer network is the cornerstone of blockchain, allowing for the creation of diverse network topologies, communication patterns between nodes, and types of nodes that participate in the operation of blockchain systems.
4. Their security is maintained through cryptographic mechanisms
   - The significance of cryptography in blockchain is undeniable, which is why Garcia-Alfaro et al. (2017) include the phrase "in code we trust" in its title because cryptography is involved in both blockchain management and security
5. They are managed through cryptographic-based consensus mechanisms, without the need for third-party intermediation
   - One key advancement brought about by blockchain is the elimination of the necessity for third-party engagement in the running of a system that is consistent with its autonomous operating capabilities.

Two elements make the definition tentative: the popularity of the superordinate used to define it, as well as the evolution of both blockchain and DLT. Carnap (2003, 65) explains that a definition's superordinate should have a "defi-

Distinguishing characteristics	Authors
Shared, distributed	(Ducas and Wilner 2017), (Hazard et al. 2016), (Mackey and Nayyar 2017), (Wu et al. 2017), (Dwivedi et al. 2019), (Oliveira et al. 2020) (Li et al. 2018), (Reyna et al. 2018), (Truby 2018), (Alharby and Van Moorsel 2018), (Hammi et al. 2018), (Dagher et al. 2018), (Savelyev 2018), (Banerjee et al. 2018), (Glaser 2017), (Khan and Salah 2018), (Kleinaki et al. 2018), (Önder and Treiblmaier 2018), (Chen 2018), (Galvez et al. 2018), (Henry et al. 2018), (Di Silvestre et al. 2018), (Gai et al. 2018), (Esposito et al. 2018), (Alzahrani and Bulusu, 2018), (Caro et al. 2018), (Cai 2018), (Burchert et al. 2018), (Tejal Shah and Shailak Jani 2018), (Andoni et al. 2019), (Kuo et al. 2019), (Min 2019), (Cichosz et al. 2019), (Li et al. 2019), (Singh et al. 2020), (Bagay 2020), (Chen et al. 2020), (Saleh 2021), (Dotan et al. 2021), (Xu et al. 2021), (Muzammal et al. 2019)
Records and keeps track of a continuously growing time-ordered list of transaction information	(Mackey and Nayyar 2017), (Wu et al. 2017), (Banerjee et al. 2018), (Galvez et al. 2018), (Jiang et al. 2018), (Dwivedi et al. 2019), (Chen et al. 2020), (Li et al. 2019), (Aditya et al. 2020), (Saleh 2021), (Hazard et al. 2016), (Ducas and Wilner 2017), (Casey et al. 2018), (Cheng et al. 2018), (Hammi et al. 2018), (Khan and Salah 2018), (Chen 2018), (Cai 2018)
Use a cryptographic-based consensus system that ensures tamper-proofing and runs autonomously without the need for third parties but is trusted by all participants	(Zhang et al. 2017), (Bocek et al. 2017), (Cheng et al. 2018), (Truby 2018), (Hammi et al. 2018), (Savelyev 2018), (Kleinaki et al. 2018), (Henry et al. 2018), (Caro et al. 2018), (Casey et al. 2018), (Min 2019), (Kamble et al. 2019), (Xu et al. 2021), (Muzammal et al. 2019)
Nodes of a peer-to-peer network	(Ducas and Wilner 2017), (Glaser 2017), (Chen 2018), (Feng et al. 2019), (Wang et al. 2019), (Aditya et al. 2020), (Singh et al. 2020), (Saleh 2021), (Oliveira et al. 2020)

Table 3. The summarized correct distinguishing characteristics employed to define blockchain

nition in use." It is mentioned by Pearson (1998, 115) that making a definition tentative demonstrates that the definition "is complete for now but maybe refined in some future date. The use of the modal allows the author to distance himself from the definition, thereby attenuating his commitment to it."

As mentioned above, DLT is a new information system artifact that has been around for a time and has not gained widespread familiarity. Furthermore, it lacks a generally accepted definition, and its properties are unknown with certainty. Nonetheless, it is used in this paper as a class term; therefore, in such cases, making the definition tentative is appropriate. Furthermore, it is clear that blockchain has evolved, rendering its qualities unclear. However, the five differentiating characteristics described in the definition are crucial and can be retained. As a result of these reservations, the definition is presented as provisional.

7.0 Conclusion

This paper proposes definitions of blockchain in the belief that definitions serve a role in fostering common understanding among interested parties by establishing sufficient and necessary conditions for the use of a term. To do this, literature from multiple academic databases was gathered and grey literature was removed. Definitions were then extracted using a semi-automated definition extraction process. A corpus of definitions was constructed from the extracted definitions, and they were analyzed.

According to the findings, eleven class words with distinct distinguishing characteristics were used to define blockchain. These genus terms and their differentiae were assessed using the Correspondence Theory of Truth, which rejects class terms and distinguishing characteristics that do not correlate to facts. Based on this method, all genus terms were rejected for use as class terms in defining blockchain, except Distributed Ledger Technology (DLT). Furthermore, differentiae that are proven to be non-factual or non-essential as determined are eliminated.

Following that, a tentative definition of blockchain is proposed, using DLT as a class word. Because there is no widely recognized definition of DLT and because the technology is always evolving, what is considered an essential component now may become a superfluous feature in the future, and the definition is kept tentative. Despite the author's assertions about the rapid evolution of blockchain, we believe that the distinguishing characteristics used are unlikely to become obsolete shortly, therefore the second reason for tentativeness is extreme caution.

Blockchain is then defined as a distributed ledger technology (DLT) used to autonomously record, share, and keep track of a continuously growing time-ordered list of transaction information that takes place between peer-to-peer network nodes that are secured by cryptographic methods and managed by cryptographic-based consensus mechanisms, eliminating the need for third-party intermediation.

8.0 Limitations

This research, like any other research, has limitations. However, these limitations do not impact the replicability or acceptability of the findings and the proposed definition. One limitation is that the research only includes definitions presented in the Aristotelian definition method, excluding other methods. This limitation means that there may be other terms that would require falsification. Secondly, the paper attempts to categorize the definitions into four categories: behavior/process/function, composition/structure, attribute/property, and location/occurrence, based on the work of Flowerdew (1992). However, the assessment of the definitions' content is subjective, which means that different individuals may have different opinions.

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References

Abe, Ryosuke, Hiroki Watanabe, Shigenori Ohashi, Shigeru Fujimura, and Atsushi Nakadaira. 2018. "Storage Protocol for Securing Blockchain Transparency". In *Proceedings of the 42nd Annual Computer Software and Applications Conference (COMPSAC)* 23-27 July 2018, 577–581. https://doi.org/10.1109/COMPSAC.2018.10298

Abelson, Raziel. 2006. "Definition". In *Encyclopedia of Philosophy*, edited by Donald M. Borchert, 664–677. Thomson Gale, Macmillan Reference.

Adere, Endale Mitiku. 2022. "Blockchain in Healthcare and IoT: A Systematic Literature Review". *Array* 14: 100139. https://doi.org/10.1016/j.array.2022.100139

Adkins, Daniel, Archita Agarwal, Seny Kamara, and Tarik Moataz. 2020. Encrypted Blockchain Databases. In *Proceedings of the 2nd ACM Conference on Advances in Financial Technologies* 21-23 October 2020 New York, USA, 241–254. New York: Association for Computing Machinery https://doi.org/10.1145/3419614.3423266

Aditya, C., Akash, M., Akash, P., Amitkumar, M., Nagarathna, K., Suraj, D., Narayan, D., and Meena, S. 2020. "Claims-Based VM Authorization on OpenStack Private Cloud using Blockchain". *Procedia Computer Science* 171: 2205–2214. https://doi.org/10.1016/j.procs.2020.04.238

Al Omar, Abdullah, Mohammad Shahriar Rahman, Anirban Basu, and Shinsaku Kiyomoto. 2017."MediBchain: A Blockchain Based Privacy Preserving Platform for Healthcare Data". In *Security, Privacy, and Anonymity in Computation, Communication, and Storage*, edited by Guojun Wang, Mohammed Atiquzzaman, Zheng Yan, andKim-Kwan Raymond Choo. Lecture Notes in Computer Science 10658, Springer International Publishing, 534–543. https://doi.org/10.1007/978-3-319-72395-2_49

Aleinikoff, T. Alexander. 1987. "Constitutional Law in the Age of Balancing". *The Yale Law Journal 96*, no.5, 943-1005. https://doi.org/10.2307/796529

Alharby, Maher, and Aad van Moorsel. 2018. "The Impact of Profit Uncertainty on Miner Decisions in Blockchain Systems". *Electronic Notes in Theoretical Computer Science* 340: 151–67. https://doi.org/10.1016/j.entcs.2018.09.011

Allon, Fiona. 2018. "Money after Blockchain: Gold, Decentralised Politics and the New Libertarianism". *Australian Feminist Studies* 33, no.96: 223–43. https://doi.org/10.1080/08164649.2018.1517245

Alzahrani, Naif, and Nirupama Bulusu. 2018. "Block-Supply Chain: A New Anti-Counterfeiting Supply Chain Using NFC and Blockchain". *Proceedings of the 1st Workshop on* Cryptocurrencies *and Blockchains for Distributed Systems - CryBlock'18 15 June 2018 Munich, Germany,* 30–35. https://doi.org/10.1145/3211933.3211939

Andoni, Merlinda, Valentin Robu, David Flynn, Simone Abram, Dale Geach, David Jenkins, Peter McCallum, and Andrew Peacock. 2019. "Blockchain Technology In The Energy Sector: A Systematic Review Of Challenges And Opportunities". *Renewable and Sustainable Energy Reviews* 100:143–174. https://doi.org/10.1016/j.rser.2018.10.014

Aste, Tomaso, Paolo Tasca, and Tiziana Di Matteo. 2017. "Blockchain Technologies: The Foreseeable Impact on

Society and Industry". *Computer* 50, no.9: 18–28. https://doi.org/10.1109/MC.2017.3571064

Avital, Michel, Roman Beck, John Leslie King, Matti Rossi, and Robin Teigland. 2016. "Jumping on the Blockchain Bandwagon: Lessons of the Past and Outlook to the Future". *In ICIS 2016. International Conference on Information Systems, Dublin Ireland*.

Bagay, Dmitry. 2020. "Blockchain-based DNS Building". *Procedia Computer Science* 169:187–191. https://doi.org/10.1016/j.procs.2020.02.134

Balal, Esmaeil, and Ruey Long Cheu. 2019. "A Metric-Concept Map for Scoping Impact Studies of a Transportation Project on Environment and Community Health". *International Journal of Transportation Science and Technology* 8, no.2: 176–91. https://doi.org/10.1016/j.ijtst.2019.05.005

Banerjee, Mandrita, Junghee Lee, and Kim-Kwang Raymon Choo. 2018. "A Blockchain Future For Internet Of Things Security: A Position Paper". *Digital Communications and Networks* 4, no.3: 149–60. https://doi.org/10.1016/j.dcan.2017.10.006

Bench-Capon, T. J. M. 1990. *Knowledge representation: An approach to artificial intelligence*. London: Academic Press.

Bhaskar, Roy. 2015. *A Realist Theory of Science*. New York: Routledge.

Bidgoli, Hossein, ed. 2003. *Encyclopedia of Information Systems*. Academic Press.

Blaschke1, Michael, Kazem Haki, Stephan Aier, and Robert Winter. 2019. "Taxonomy of Digital Platforms: A Platform Architecture Perspective". In *14th International Conference on Wirtschaftsinformatik 24-27February 2019 Siegen, Germany.*

Bocek, Thomas, Bruno B. Rodrigues, Tim Strasser, and Burkhard Stiller. 2017. "Blockchains Everywhere—A Use-Case Of Blockchains in the Pharma Supply-Chain". *2017 IFIP/IEEE Symposium on Integrated Network and Service Management (IM)*, 772–777. https://doi.org/10.23919/INM.2017.7987376

Bolshakov, Igor A., and Alexander Gelbukh. 2004. *Computational Linguistics: Models, Resources, Applications*. Instituto Politécnico Nacional: Universidad Nacional Autónoma de México : Fondo de Cultura Económica.

Bowker, Lynne, and Jennifer Pearson. 2002. *Working With Specialized Language: A Practical Guide to Using Corpora*. Routledge.

Brachman, Ronald J., and Hector J. Levesque. 2004. *Knowledge Representation and Reasoning*. San Francisco: Morgan Kaufmann.

Burchert, Conrad, Christian Decker, and Roger Wattenhofe. 2018. "Scalable Funding of Bitcoin Micropayment Channel Networks". *Royal Society Open Science* 5, no.8: 180089. https://doi.org/10.1098/rsos.180089

Cai, Cynthia Weiyi. 2018. "Disruption of Financial Intermediation By Fintech: A Review On Crowdfunding And Blockchain". *Accounting & Finance* 58, no.4: 965–92. https://doi.org/10.1111/acfi.12405

Carnap, Rudolph. 2003. *The Logical Structure of The World and Pseudoproblems in Philosophy*. Open Court Classics.

Caro, Miguel Pincheira, Muhammad Salek Ali, Massimo Vecchio, and Raffaele Giaffreda. 2018. "Blockchain-based Traceability in Agri-Food Supply Chain Management: A Practical Implementation. *2018 IoT Vertical and Topical Summit on Agriculture - Tuscany (IOT Tuscany)*, 8-9 May 2018, 1–4. https://doi.org/10.1109/IOT-TUSCANY.2018.8373021

Casey, Michael, Jonah Crane, Gary Gensler, Simon Johnson, and Neha Narula. 2018. *The Impact Of Blockchain Technology On Finance: A Catalyst For Change*. ICMB International Center for Monetary and Banking Studies.

Cavell, Stanley. 1976. *Must We Mean What We Say? A Book of Essays*. Cambridge University Press.

Chen, Long, Lin William Cong, and Yizhou Xiao. 2020. "A Brief Introduction to Blockchain Economics". In *Information for Efficient Decision Making*, edited by K. R. Balachandran, 1–40. World Scientific. https://doi.org/10.1142/9789811220470_0001

Chen, Yan. 2018. "Blockchain Tokens and The Potential Democratization of Entrepreneurship and Innovation". *Business Horizons* 61, no.4: 567–75. https://doi.org/10.1016/j.bushor.2018.03.006

Cheng, Edward C., Ying Le, Jia Zhou, and Yang Lu. 2018. "Healthcare Services Across China – On Implementing an Extensible Universally Unique Patient Identifier System." *International Journal of Healthcare Management* 11, no.3, 210–16. https://doi.org/10.1080/20479700.2017.1398388

Chowdhary, K. R. 2020. "Natural Language Processing". In *Fundamentals of Artificial Intelligence,* 603–649. New Dehli: Springer. https://doi.org/10.1007/978-81-322-3972-7_19

Chowdhury, Mohammad Jabed Morshed, Alan Colman, Muhammad Ashad Kabir, Jun Han, and Paul Sarda. 2018. "Blockchain Versus Database: A Critical Analysis". In *17th IEEE International Conference On Trust, Security And Privacy In Computing And Communications/ 12th IEEE International Conference On Big Data Science And Engineering (TrustCom/BigDataSE)*, 1348–1353. https://doi.org/10.1109/TrustCom/BigDataSE.2018.00186

Cichosz, Simon Lebech, Mads Nibe Stausholm, Thomas Kronborg, Peter Vestergaard, and Ole Hejlesen. 2019. "How to Use Blockchain for Diabetes Health Care Data and Access Management: An Operational Concept".

Journal of Diabetes Science and Technology 13, no.2: 248–53. https://doi.org/10.1177/1932296818790281

Confucius.1996. *The Wisdom of Confucius*. Carol Publishing Group.

Conoscenti, Marco, Antonio Vetrò, and Juan Carlo de Martin. 2016. "Blockchain for the Internet of Things: A systematic Literature Review". In *Proceedings of the 13th International Conference of Computer Systems and Applications (AICCSA) 29 November 2016 - 02 December 2016 Agadir, Morocco*. IEEE. https://doi.org/10.1109/AICCSA.2016.7945805

Constantinides, Panos, Ola Henfridsson, and Geoffrey G. Parker. 2018. "Introduction—Platforms and Infrastructures in the Digital Age". *Information Systems Research* 29, no.2: 381–400. https://doi.org/10.1287/isre.2018.0794

Dagher, Gaby G., Jordan Mohler, Matea Milojkovic, and Praneeth Babu Marella. 2018. "Ancile: Privacy-preserving Framework For Access Control And Interoperability Of Electronic Health Records Using Blockchain Technology". *Sustainable Cities and Society* 39: 283–97. https://doi.org/10.1016/j.scs.2018.02.014

Dai, Juan, and Miklos A. Vasarhelyi. 2017. "Toward Blockchain-Based Accounting and Assurance". *Journal of Information Systems* 31, no.3: 5–21. https://doi.org/10.2308/isys-51804

Danzi , Pietro, Anders Ellersgaard Kalor, Cedomir Stefanovic, and Petar Popovski 2018. "Analysis of the Communication Traffic for Blockchain Synchronization of IoT Devices". *2018 IEEE International Conference on Communications (ICC)*, 20-24 May 2018 Kansas City, USA, 1–7. https://doi.org/10.1109/ICC.2018.8422485

De Filippi, Primavera, Morshed Mannan, Wessel Reijers. 2020. "Blockchain as a Confidence Machine: The Problem Of Trust & Challenges Of Governance". *Technology in Society* 62: 101284. https://doi.org/10.1016/j.techsoc.2020.101284

De Reuver, Mark, Carsten Sørensen, and Rahul Basole. 2018. "The Digital Platform: A Research Agenda". *Journal of Information Technology* 33, no.2: 124–35. https://doi.org/10.1057/s41265-016-0033-3

Deslauriers, Marguerite. 2007. *Aristotle on Definition*. Boston: Brill.

Dhillon, Vikram, David Metcalf, and Max Hooper. 2018. *Blockchain Enabled Applications: Understand the Blockchain Ecosystem and How To Make it Work For You*. Apress.

Di Silvestre, M. L., P. Gallo, P., M.G. Ippolito, E.R. Sanseverino, G. Sciume, and G. Zizzo. 2018. "An Energy Blockchain, a Use Case on Tendermint". In *2018 IEEE International Conference on Environment and Electrical Engineering and 2018 IEEE Industrial and Commercial Power Systems Europe (EEEIC / I&CPS Europe) 12-15 June 2018 Palermo, Italy*, 1–5. https://doi.org/10.1109/EEEIC.2018.8493919

Dotan, Maya, Yvonne-Anne Pignolet, Stefan Schmid, Saar Tochner, and Aviv Zohar. 2021. "Survey on Blockchain Networking: Context, State-of-the-Art, Challenges". *ACM Computing Surveys* 54, no.5: 1–34. https://doi.org/10.1145/3453161

Downing, Douglas, ed. 2009. *Dictionary of Computer and Internet Terms*. 10th ed. Barron's Educational Series.

Du, Wenyu (Derek), Shan L. Pan, Dorothy E. Leidner, and Wenchi Ying. 2019. Affordances, Experimentation and Actualization of FinTech: A Blockchain Implementation Study. *The Journal of Strategic Information Systems* 28, no.1: 50–65. https://doi.org/10.1016/j.jsis.2018.10.002

Ducas, Evangeline, and Alex Wilner. 2017. "The security And Financial Implications Of Blockchain Technologies: Regulating Emerging Technologies in Canada. *International Journal: Canada's Journal of Global Policy Analysis* 72, no.4: 538–62. https://doi.org/10.1177/0020702017741909

Dwivedi, Ashutoshi, Gautam Srivastava, Shalini Dhar, and Rajani Singh. 2019. "A Decentralized Privacy-Preserving Healthcare Blockchain for IoT". *Sensors* 19, no.2: 326. https://doi.org/10.3390/s19020326

Dwork, Cynthia, and Moni Naor. 1993. "Pricing via Processing or Combatting Junk Mail". In *Advances in Cryptology—CRYPTO' 92*, edited by E. F. Brickell. Lecture Notes in Computer Science 740. Springer Berlin Heidelberg, 139–147. https://doi.org/10.1007/3-540-48071-4_10

Eberhardt, Jacob, and Stefan Tai. 2017. "On or Off the Blockchain? Insights on Off-Chaining Computation and Data". In *Service-Oriented and Cloud Computing,* edited by Flavio De Paoli, Stefan Schulte, and Einar Broch Johnsen. Lecture Notes in Computer Science 10465. Springer International Publishing, 3-5. https://doi.org/10.1007/978-3-319-67262-5_1

Efanov, Dmitry, and Pavel Roschin. 2018. "The All-Pervasiveness of the Blockchain Technology". *Procedia Computer Science* 123: 116–21. https://doi.org/10.1016/j.procs.2018.01.019

Ehmke, Christopher, Florian Wessling, and Christoph M. Friedrich. 2018. "Proof-of-property: A Lightweight and Scalable Blockchain Protocol. In *Proceedings of the 1st International Workshop on Emerging Trends in Software Engineering for Blockchain - WETSEB '18* 27 May 2018 Gothenburg, Sweden. New York: Association for Computing Machinery, 48–51. https://doi.org/10.1145/3194113.3194122

Esposito, Christian, Alfredo De Santis, Genny Tortora, Henry Chang, and Kim-Kwang Raymond Choo. 2018. "Blockchain: A Panacea for Healthcare Cloud-Based

Data Security and Privacy?" *IEEE Cloud Computing* 5, no.1: 31–37. https://doi.org/10.1109/MCC.2018.0117 91712

Farooq, Muhammad Shoaib, Zareen Kalim, Junaid Nasir Qureshi, Saim Rasheed, and Adnan Abid. 2022. "A Blockchain-Based Framework for Distributed Agile Software Development." *IEEE Access* 10: 17977–17995. https://doi.org/10.1109/ACCESS.2022.3146953

Feng, Qi., Debiao He, Sherali Zeadally, Muhammad Khurram Khan, and Neeraj Kumar. 2019. "A Survey on Privacy Protection in Blockchain System". *Journal of Network and Computer Applications* 126: 45–58. https://doi.org/10.1016/j.jnca.2018.10.020

Flowerdew, John. 1992. "Definitions in Science Lectures". *Applied Linguistics* 13, no.2: 202–21. https://doi.org/10.1093/applin/13.2.202

Flowerdew, Lynne. 2004. "The Argument For Using English Specialized Corpora To Understand Academic And Professional Language". In *Discourse in the Professions: Perspectives from Corpus Linguistics*, edited by Ulla Connor and Thomas A. Upton, 11-33. John Benjamins Publishing Company.

Fodor, Jerry A. 1981. *Representations: Philosophical Essays on the Foundations of Cognitive Science*. MIT Press.

Fodor, Jerry A. 1998. *Concepts: Where Cognitive Science Went Wrong*. Clarendon Press; Oxford University Press.

Gai, Keke, Kim-Kwan Raymond Choo, and Liehuang Zhu. 2018. "Blockchain-Enabled Reengineering of Cloud Datacenters". *IEEE Cloud Computing* 5, no.6: 21–25. https://doi.org/10.1109/MCC.2018.064181116

Galvez, Juan F., J.C. Mejuto, and J. Simal-Gandara. 2018. "Future Challenges on The Use of Blockchain For Food Traceability Analysis". *TrAC Trends in Analytical Chemistry* 107: 222–32. https://doi.org/10.1016/j.trac.2018.08.011

Garcia-Alfaro, Joaquim, Guillermo Navarro-Arribas, Hannes Hartenstein, and Jordi Herrera-Joancomartí, eds. 2017. *Data Privacy Management, Cryptocurrencies and Blockchain Technology: Proceedings ESORICS 2017 International Workshops, DPM 2017 and CBT 2017, 14-15 September, 2017 Oslo, Norway.* Lecture Notes in Computer Science vol. 10436. Springer International Publishing. https://doi.org/10.1007/978-3-319-67816-0

Glaser, Florian. 2017. "Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain enabled System and Use Case Analysis". In *Proceedings of 50th Hawaii International Conference on System Sciences (HICSS-50), 4 - 7 January 2017 Hawaii,* 1543-1552. AIS eLibrary (AISeL) https://doi.org/10.5445/IR/100007 3702

Halpern, Diane F. 2014. *Thought and Knowledge: An Introduction to Critical Thinking*. 5th ed. Psychology Press.

Hammi, Mohamed Tahar, Badis Hammi, Patrick Bellot, and Ahmed Serhrouchni. 2018. "Bubbles of Trust: A Decentralized Blockchain-Based Authentication System for IoT". *Computers & Security* 78: 126–42. https://doi.org/10.1016/j.cose.2018.06.004

Hancock, Matthew, and Ed Vaizey. 2016. *Distributed Ledger Technology: Beyond block chain* [A report by the UK Government Chief Scientific Adviser]. Government Office for Science. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf

Harman, Gilbert. 1999. *Reasoning, Meaning, and Mind*. Clarendon Press; Oxford University Press.

Hartmann, R. R. K., and Gregory James. 2002. *Dictionary of Lexicography*. London and New York: Taylor & Francis.

Hayes, Patrick. 1999. "Knowledge Representation". In *The MIT Encyclopedia of the Cognitive Sciences, edited by* Robert A. Wilson and Frank C. Keil, 432–433. MIT Press.

Hazard, James, Odysseas Sclavounis, O., and Harald Stieber. 2016. "Are Transaction Costs Drivers of Financial Institutions? Contracts Made in Heaven, Hell, and the Cloud in Between". In *Banking Beyond Banks and Money*, edited by Paolo Tasca, Tomaso Aste, Loriana Pelizzon, and Nicolas Perony , 213–237. Springer International Publishing. https://doi.org/10.1007/978-3-319-42448-4_12

Henderson, Harry. 2009. *Encyclopedia of Computer Science and Technology.* Rev. ed. New York: Facts On File.

Henry, Ryan, Amir Herzberg, and Aniket Kate. 2018. "Blockchain Access Privacy: Challenges and Directions". *IEEE Security and Privacy* 16, no.4: 38–45. https://doi.org/10.1109/MSP.2018.3111245

Hurley, Patrick J. 2015. *A Concise Introduction to Logic. 12th ed.* Cengage Learning.

Iansiti, Marco, and Karim R. Lakhani, K. R. 2017. "The Truth About Blockchain", *Harvard Business Review, From the Magazine*, January-February 2017. https://hbr.org/2017/01/the-truth-about-blockchain

Jiang, Shan, Jiannong Cao, Hanqing Wu, Yanni Yang, Mingyu Ma, and Jianfei He 2018. "BlocHIE: A BLOCkchain-Based Platform for Healthcare Information Exchange". In *2018 IEEE International Conference on Smart Computing (SMARTCOMP), 18-20 June 2018 Taormina, Italy,* 49–56. IEEE https://doi.org/10.1109/SMARTCOMP.2018.00073

John, Deborah Roedder, Barabar Loken, Kyeongheui Kim, and Alokparna Basu Monga. 2006. "Brand Concept Maps: A Methodology for Identifying Brand Association Networks". *Journal of Marketing Research* 43, no. 4: 549–63. https://doi.org/10.1509/jmkr.43.4.549

Jordan, M. I., and T.M. Mitchell. 2015. "Machine learning: Trends, Perspectives, and Prospects". *Science*, 349, no.6245: 255–60. https://doi.org/10.1126/science.aaa8415

Kamble, Sachin, Angappa Gunasekaran, and Himanshu Arha. 2019. "Understanding the Blockchain Technology Adoption in Supply Chains-Indian Context". *International Journal of Production Research* 57, no.7: 2009–2033. https://doi.org/10.1080/00207543.2018.1518610

Keen, Peter G. W. 1980. "MIS Research: Reference Disciplines and a Cumulative Tradition". In *International Conference on Information Systems (ICIS) 1980: Proceedings*. https://aisel.aisnet.org/icis1980/

Khan, Minhaj Ahmad, and Khaled Salah. 2018. "IoT security: Review, Blockchain Solutions, And Open Challenges". *Future Generation Computer Systems* 82: 395–411. https://doi.org/10.1016/j.future.2017.11.022

Khosrow-Pour, Mehdi, ed. 2005. *Encyclopedia of Information Science and Technology*. Idea Group Reference.

Kleinaki, Athina-Styliani, Petros Mytis-Gkometha, George Drosatosb, Pavlos S. Efraimidisa, Eleni Kaldoudi. 2018. "A Blockchain-Based Notarization Service for Biomedical Knowledge Retrieval". *Computational and Structural Biotechnology Journal* 16: 288–97. https://doi.org/10.1016/j.csbj.2018.08.002

Kouhizadeh, Mahtab, Sara Saberi, and Joseph Sarkis. 2021. "Blockchain Technology and the Sustainable Supply Chain: Theoretically Exploring Adoption Barriers". *International Journal of Production Economics* 231: 107831. https://doi.org/10.1016/j.ijpe.2020.107831

Krause, Solvej, Harish Natarajan, and Helen Gradstein. 2017. *Distributed Ledger Technology (DLT) and Blockchain*. FinTech Note, no.1 . The World Bank Group. https://documents1.worldbank.org/curated/en/177911513714062215/pdf/122140-WP-PUBLIC-Distributed-Ledger-Technology-and-Blockchain-Fintech-Notes.pdf

Krylov, G. O., and V.M Seleznev. 2019. "Current State and Development Trends of Blockchain Technology in the Financial Sector". *Finance: Theory and Practice* 23, no. 6: 26–35. https://doi.org/10.26794/2587-5671-2019-23-6-26-35

Kuhn, Thomas S. 1996. *The structure Of Scientific Revolutions*. 3rd ed. University of Chicago Press.

Kuo, Tsung-Ting, Hugo Zavaleta Rojas, and Lucila Ohno-Machado. 2019. "Comparison of Blockchain Platforms: A Systematic Review And Healthcare Examples". *Journal of the American Medical Informatics Association* 26, no.5: 462–78. https://doi.org/10.1093/jamia/ocy185

Lamport, Leslie, Robert Shostak, and Marshall Pease. 1982. "The Byzantine Generals Problem". *ACM Transactions on Programming Languages and Systems* 4, no.3: 382–401. https://doi.org/10.1145/357172.357176

Larsen, Kai R., and Chih How Bong. 2016. "A Tool for Addressing Construct Identity in Literature Reviews and Meta-Analyses". *MIS Quarterly 40*, no. 3: 529–51. https://doi.org/10.25300/MISQ/2016/40.3.01

Li, Jiaxing, Jigang Wu, and Long Chen. 2018. "Block-secure: Blockchain Based Scheme for Secure P2P Cloud Storage". *Information Sciences* 465: 219–31. https://doi.org/10.1016/j.ins.2018.06.071

Li, Zhi, Xinlai Liu, W.M. Wang, Ali Vatankhah Barenji, and George Q. Huang. 2019. " CKshare: Secured Cloud-Based Knowledge-Sharing Blockchain for Injection Mold Redesign". *Enterprise Information Systems* 13, no.1: 1–33. https://doi.org/10.1080/17517575.2018.1539774

Liu, Bin, Xiao Liang Yu, Shiping Chen, Xiwei Xu, and Liming Zhu. 2017. "Blockchain Based Data Integrity Service Framework for IoT Data." In *2017 IEEE International Conference on Web Services (ICWS) 25-30 June 2017 Honolulu, USA. IEEE,* 468–475. https://doi.org/10.1109/ICWS.2017.54

Lombardi, Federico, Leonardo Aniello, Stefano De Angelis, Andrea Margheri, and V. Sassone. 2018. "A Blockchain-based Infrastructure for Reliable and Cost-effective IoT-aided Smart Grids". In *Living in the Internet of Things: Cybersecurity of the IoT - 2018*, 42 https://doi.org/10.1049/cp.2018.0042

Lune, Howard, and Bruce L. Berg. 2017. *Qualitative Research Methods for The Social Sciences*. 9th ed. Pearson.

Lyytinen, Kalle J. 1985. "Implications of Theories of Language for Information Systems". *MIS Quarterly* 9, no.1: 61-74. https://doi.org/10.2307/249274

Lyytinen, Kalle J. 1987. "Different Perspectives on Information Systems: Problems and Solutions". *ACM Computing Surveys* 19, no.1: 5–46. https://doi.org/10.1145/28865.28867

MacDonald, Trent J., Darcy W.E. Allen, and Jason Potts. 2016. "Blockchains and the Boundaries of Self-Organized Economies: Predictions for the Future of Banking". In *Banking Beyond Banks and Money*, edited by Paolo Tasca, Tomaso Aste, Loriana Pelizzon, and Nicolas Perony, 279–296. Springer International Publishing. https://doi.org/10.1007/978-3-319-42448-4_14

MacKenzie, Scott B. 2003. "The Dangers of Poor Construct Conceptualization". *Journal of the Academy of Marketing Science* 31, no.3: 323–26. https://doi.org/10.1177/0092070303031003011

Mackey, Tim K., and Gaurvika Nayyar. 2017. "A Review of Existing and Emerging Digital Technologies To Combat The Global Trade In Fake Medicines". *Expert Opinion on Drug Safety* 16, no.5: 587–602. https://doi.org/10.1080/14740338.2017.1313227

March, Salvatore T., and Gerald F. Smith.1995. "Design and Natural Science Research on Information Technology". *Decision Support Systems* 15, no.4: 251–66. https://doi.org/10.1016/0167-9236(94)00041-2

Matteo Benčić, Federico, and Ivana Podnar Žarko. 2018. "Distributed Ledger Technology: Blockchain Compared to Directed Acyclic Graph". Preprint, https://ui.adsabs.harvard.edu/abs/2018arXiv180410013M

Meyer, Ingrid. 2001. "Extracting Knowledge-Rich Contexts for Terminography: A Conceptual and Methodological Framework". In *Recent Advances in Computational Terminology*, edited by Didier Bourigault, Christian Jacquemin and Marie-Claude L'Homme. Natural Language Processing 2. John Benjamins Publishing Company, 279–302. https://doi.org/10.1075/nlp.2.15mey

Min, Hokey. 2019. "Blockchain Technology for Enhancing Supply Chain Resilience". *Business Horizons* 62, no.1: 35–45. https://doi.org/10.1016/j.bushor.2018.08.012

Minoli, Daniel, and Benedict Occhiogrosso. 2018. "Blockchain Mechanisms for IoT Security". *Internet of Things* 1–2: 1–13. https://doi.org/10.1016/j.iot.2018.05.002

Minsky, Marvin. 1988. "A Framework for Representing Knowledge". In *Readings in Cognitive Science*, edited by Allan Collins and Edward E. Smith, 156–189. Elsevier. https://doi.org/10.1016/B978-1-4832-1446-7.50018-2

Muhammad, Iqbal, and Zhu Yan. 2015. "Supervised Machine Learning Approaches: A Survey". *ICTACT Journal on Soft Computing* 5, no.3: 946–52. https://doi.org/10.21917/ijsc.2015.0133

Munson, Ronald, and Andrew Black. 2010. *The Elements of Reasoning*. 6th ed. Wadsworth.

Muzammal, Muhammad, Qiang Qu, and Bulat Nasrulin. 2019. "Renovating Blockchain With Distributed Databases: An Open Source System". *Future Generation Computer Systems 90*: 105–17. https://doi.org/10.1016/j.future.2018.07.042

Nasteski, Vladimir. 2017. "An Overview of The Supervised Machine Learning Methods". *Horizons.B* 4: 51–62.

Nathan, Senthil, Chander Govindarajan, Adarsh Saraf, Manish Sethi, and Praveen Jayachandran. 2019. "Blockchain Meets Database: Design and Implementation of a Blockchain Relational Database". *Proceedings of the VLDB Endowment* 12, no. 11: 1539–1552. https://doi.org/10.14778/3342263.3342632

Newman, Andrew. 2002. *The Correspondence Theory of Truth: An Essay On The Metaphysics Of Predication*. Cambridge University Press.

Niazi, Mahmood, Sajjad Mahmood, Mohammad Alshayeb, Mohammed Rehan Riaz, Kanaan Faisal, Narciso Cerpa, Siffat Ullah Khan, and Richardson, Ita. 2016. "Challenges of Project Management In Global Software Development: A Client-Vendor Analysis". *Information and Software Technology* 80:1–19. https://doi.org/10.1016/j.infsof.2016.08.002

Nickel, Maximilian, Kevin Murphy, Volker Tresp, and Evgeny Gabrilovich. 2016. "A Review of Relational Machine Learning for Knowledge Graphs". *Proceedings of the IEEE* 104, no.1: 11–33. https://doi.org/10.1109/JPROC.2015.2483592

Novak, Joseph D. 1990. "Concept Mapping: A Useful Tool for Science Education". *Journal of Research in Science Teaching* 27, no. 10: 937–49. https://doi.org/10.1002/tea.3660271003

Novo, Oscar. 2018. "Blockchain Meets IoT: An Architecture for Scalable Access Management in IoT". *IEEE Internet of Things Journal* 5, no.2: 1184–1195. https://doi.org/10.1109/JIOT.2018.2812239

Oliveira, Marcela T. de, Lúcio H.A. Reis, Dianne S.V. Medeiros, Ricardo R. Carrano, Silvia D. Olabarriaga, and Diogo M.F. Mattos. 2020. "Blockchain Reputation-Based Consensus: A Scalable And Resilient Mechanism For Distributed Mistrusting Applications". *Computer Networks*, 179:107367. https://doi.org/10.1016/j.comnet.2020.107367

Önder, Irem, and Horst Treiblmaier. 2018. "Blockchain and Tourism: Three Research Propositions". *Annals of Tourism Research* 72: 180–82. https://doi.org/10.1016/j.annals.2018.03.005

Orlikowski, Wanda, and C. Suzanne Iacono. 2001. "Research Commentary: Desperately Seeking the 'IT' in IT Research: A Call to Theorizing the IT Artifact". *Information Systems Research* 12, no.2: 121–34. https://doi.org/10.1287/isre.12.2.121.9700

Özsu, M. Tamer, and Patrick Valduriez. 2011. *Principles of Distributed Database Systems.* 3rd ed. Springer: New York. https://doi.org/10.1007/978-1-4419-8834-8

P., Swathi, and M. Venkatesan. 2021. "Scalability Improvement And Analysis Of Permissioned-Blockchain". *ICT Express* 7, no.3: 283–89. https://doi.org/10.1016/j.icte.2021.08.015

Parnas, D. L. 1990. Education for Computing Professionals. *Computer* 23, no.1: 17–22. https://doi.org/10.1109/2.48796

Patel, Vishal. 2018. "A Framework For Secure And Decentralized Sharing Of Medical Imaging Data Via Blockchain Consensus". *Health Informatics Journal*, 146045821876969. https://doi.org/10.1177/1460458218769699

Pazaitis, Alex, Primavera De Filippi, and Vasilis Kostakis. 2017. "Blockchain and Value Systems In The Sharing Economy: The Illustrative Case Of Backfeed". *Technological Forecasting and Social Change* 125: 105–115. https://doi.org/10.1016/j.techfore.2017.05.025

Pearson, Jennifer. 1998. *Terms in Context*. John Benjamin's Publishing Company.

Pervez, Huma, M. Muneeb, Muhammad Usama Irfan, and I. Haq. 2018. "A Comparative Analysis of DAG-Based

Blockchain Architectures". In *12th International Conference on Open Source Systems and Technologies (ICOSST)*, 27–34. https://doi.org/10.1109/ICOSST.2018.8632193

Peters, Gareth W., and Efstathios Panayi. 2016. "Understanding Modern Banking Ledgers Through Blockchain Technologies: Future of Transaction Processing and Smart Contracts on the Internet of Money". In *Banking Beyond Banks and Money*, edited by Paolo Tasca, Tomaso Aste, Loriana Pelizzon, and Nicolas Perony, 239–278. Springer International Publishing. https://doi.org/10.1007/978-3-319-42448-4_13

Pinno, Otto Julio Ahlert, Andre Ricardo Abed Gregio, and Luis C. E. De Bona. 2017. "ControlChain: Blockchain as a Central Enabler for Access Control Authorizations in the IoT". In *GLOBECOM 2017 - 2017 IEEE Global Communications Conference* 04-08 December 2017 Singapore, IEEE, 1–6. https://doi.org/10.1109/GLOCOM.2017.8254521

Provalis Research. 2021. *User's Guide WORDSTAT 9 Text Analytics Software*. Provalis Research. https://provalisresearch.com/Documents/WordStat9.pdf

Przytarski, Dennis, Christoph Stach, Clémentine Gritti, and Bernhard Mitschang. 2021. Query Processing in Blockchain Systems: Current State and Future Challenges. *Future Internet* 14, no. 1:1. https://doi.org/10.3390/fi14010001

Qiu, Tianyi, Ruidong Zhang, and Yuan Gao Y. 2019. "Ripple vs. SWIFT: Transforming Cross Border Remittance Using Blockchain Technology". *Procedia Computer Science* 147: 428–34. https://doi.org/10.1016/j.procs.2019.01.260

Qu, Chao, Ming Tao, Jie Zhang, Xiaoyu Hong, and Ruifen Yuan. 2018. "Blockchain Based Credibility Verification Method for IoT Entities". *Security and Communication Networks*, 1–11. https://doi.org/10.1155/2018/7817614

Quine, Willard Van Orman. 1997. *The Ways of Paradox And Other Essays*. 7th ed. rev. and enl. ed. Cambridge, Massachusetts and London: Harvard University Press.

Rahimi, Saeed, and Frank S. Haug. 2010. *Distributed Database Management Systems: A Practical Approach*. Wiley ; IEEE Computer Society.

Raikwar, Mayank, Danolo Gligoroski, and Goran Velinov. 2020. "Trends in Development of Databases and Blockchain." In *Seventh International Conference on Software Defined Systems (SDS)*, 177–182. https://doi.org/10.1109/SDS49854.2020.9143893

Rauchs, Michel, Andrew Glidden, Brian Gordon, Gina Pieters, Martino Recanatini, François Rostand, Kathryn Vagneur, and Bryan Zhang. 2018. *Distributed Ledger Technology Systems. A Conceptual Framework*. Cambridge Centre for Alternative Finance, Cambridge Judge Business School, University of Cambridge. https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/2018-10-26-conceptualising-dlt-systems.pdf

Rey, Alain. 2000. "Introduction: Defining Definition". In *Essays on Definition*, edited by Juan C. Sager, 1-14. Amsterdam/Philadelphia: John Benjamins.

Reyna, Ana, Cristian Martín, Jaime Chen, Enrique Soler, and Manuel Díaz. 2018. "On Blockchain and Its Integration with Iot. Challenges and Opportunities". *Future Generation Computer Systems* 88: 173–190. https://doi.org/10.1016/j.future.2018.05.046

Rickert, Heinrich. 2000. "The Theory of Definitions". In *Essays on Definition,* edited by Juan C. Sager, 191–248. John Benjamin's Publishing Company.

Riemer, Nick. 2010. *Introducing Semantics*. Cambridge University Press.

Ross, Sir David, John Lloyd Ackrill, and William David Ross. 2004. *Aristotle*. 6th ed. Routledge.

Ruan, Pingcheng, Tien Tuan Anh Dinh, Dumitrel Loghin, Meihui Zhang, Gang Chen, Qian Lin, and Beng Chin. 2021. "Blockchains vs. Distributed Databases: Dichotomy and Fusion". In *Proceedings of the 2021 International Conference on Management of Data* June 20 - 25 2021, China, 1504–1517. New York Association for Computing Machineryhttps://doi.org/10.1145/3448016.3452789

Russell, Bertrand. 1908. "Mathematical Logic as Based on the Theory of Types". *American Journal of Mathematics* 30, no.3: 222. https://doi.org/10.2307/2369948

Saberi, Sara, Mahtab Kouhizadeh, Joseph Sarkis, and Lejia Shen. 2019. "Blockchain Technology and Its Relationships to Sustainable Supply Chain Management." *International Journal of Production Research* 57, no.7: 2117–2135. https://doi.org/10.1080/00207543.2018.1533261

Saleh, Fahad. 2021. "Blockchain without Waste: Proof-of-Stake". *The Review of Financial Studies* 34, no.3: 1156–1190. https://doi.org/10.1093/rfs/hhaa075

Savelyev, Alexander. 2018. "Copyright in the Blockchain Era: Promises and Challenges". *Computer Law & Security Review* 34, no.3: 550–61. https://doi.org/10.1016/j.clsr.2017.11.008

Schiappa, Edward. 2003. *Defining Reality: Definitions and the Politics of Meaning*. Southern Illinois University Press.

Shrivastava, Suprika Vasudeva, and Hema Date. 2010. "Distributed Agile Software Development: A Review". Preprint, submitted June 10, 2010 (arXiv:1006.1955). arXiv. http://arxiv.org/abs/1006.1955

Singh, Sushil Kumar, Shailendra Rathore, and Jong Hyuk Park. 2020." BlockIoTIntelligence: A Blockchain-enabled Intelligent IoT Architecture with Artificial Intelligence". *Future Generation Computer Systems* 110: 721–43. https://doi.org/10.1016/j.future.2019.09.002

Starr, Rodrigo Rizzi, and José Maria Parente de Oliveira. 2013. "Concept Maps as The First Step in an Ontology Construction Method". *Information Systems* 38, no. 5: 771–83. https://doi.org/10.1016/j.is.2012.05.010

Swan, Melanie. 2015. *Blockchain: Blueprint for a New Economy*. O'Reilly Media, Inc.

Szabo, Nick. 1997. "Formalizing and Securing Relationships on Public Networks". *First Monday* 2, no. 9. https://doi.org/10.5210/fm.v2i9.548

Tejal Shah, and Shailak Jani. 2018. *Applications of Blockchain Technology in Banking & Finance*. https://doi.org/10.13140/RG.2.2.35237.96489

Teubert, Wolfgang, and Anna Cermakova. 2004. "Directions in Corpus Linguistics". In *Lexicology and corpus linguistics: An introduction*, edited by M. A. K. Halliday, Anna Cermakova, Wolfgang Teubert, and Colin Yallop, 113-166. London and New York: Continuum.

Tilson, David, Kalle Lyytinen, and Carsten Sørensen. 2010. "Research Commentary —Digital Infrastructures: The Missing IS Research Agenda". *Information Systems Research* 21, no.4: 748–59. https://doi.org/10.1287/isre.1100.0318

Tognini-Bonelli, Elena. 2001. *Corpus Linguistics at Work*. Studies in Corpus Linguistics 6. John Benjamins Publishing Company.

Truby, Jon. 2018. "Decarbonizing Bitcoin: Law and Policy Choices for Reducing the Energy Consumption of Blockchain Technologies and Digital Currencies". *Energy Research & Social Science* 44: 399–410. https://doi.org/10.1016/j.erss.2018.06.009

Usama, Muhammad, Junaid Qadir, Aunn Raza, Hunain Arif, Kok-lim Alvin Yau, Yehia Elkhatib, Amir Hussain, and Ala Al-Fuqaha. 2019. "Unsupervised Machine Learning for Networking: Techniques, Applications and Research Challenges". *IEEE Access* 7: 65579–65615. https://doi.org/10.1109/ACCESS.2019.2916648

Vargas, Rocio, Amir Mosavi, and Ramon Ruiz. 2018. "Deep Learning: A Review". Preprint, submitted 6 October 2018 / Approved: 10 October 2018 / *Mathematics & Computer Science.* https://doi.org/10.20944/preprints201810.0218.v1

Vishnumurthy, Vivek, Sangeeth Chandrakumar, and Emin Gün Sirer. 2003. *KARMA : A Secure Economic Framework for Peer-to-Peer Resource Sharing*. https://www.cs.cornell.edu/people/egs/714-spring05/karma.pdf

Walton, Douglas. 2001. "Persuasive Definitions and Public Policy Arguments". *Argumentation and Advocacy* 37, no.3): 117–32. https://doi.org/10.1080/00028533.2001.11951664

Wang, Licheng, Xiaoying Shen, Jing Li, Jun Shao, and Yixian Yang. 2019. Cryptographic Primitives in Blockchains. *Journal of Network and Computer Applications 127*: 43–58. https://doi.org/10.1016/j.jnca.2018.11.003

Wang, Yingli, Jeong Hugh Han, and Paul Beynon-Davies. 2019. "Understanding Blockchain Technology For Future Supply Chains: A Systematic Literature Review And Research Agenda". *Supply Chain Management: An International Journal* 24, no.1: 62–84. https://doi.org/10.1108/SCM-03-2018-0148

Westerhout, Eline. 2009a. "Definition Extraction Using Linguistic and Structural Features". In *Proceedings of the 1st International Workshop on Definition Extraction* 18 September 2009 Borovets, Bulgaria, edited by Gerard Sierra, Mara Pozzi and Juan-Manuel Torres, 61–67.

Westerhout, Eline. 2009b. "Extraction of Definitions Using Grammar-Enhanced Machine Learning." In *Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics: Student Research Workshop* 2 April 2009 Athens, Greece, edited by Vera Demberg, Yanjun Ma, and Nils Reiter, 88–96. The Association for Computer Linguistics.

Westerhout, Eline. 2010. *Definition Extraction for Glossary Creation: A Study on Extracting Definitions for Semi-Automatic Glossary Creation in Dutch*. Utrecht: LOT.

Whitehead, Alfred North, and Bertrand Russell. 2011. *Principia Mathematica*. Rough Draft Printing.

Winograd, Terry. 1986. "A Language/Action Perspective on the Design of Cooperative Work". In *Proceedings of the 1986 ACM Conference on Computer-Supported Cooperative Work - CSCW '86* 3-6 December 1986 Austin, Texas, 203-220. https://doi.org/10.1145/637069.637096

Wittgenstein, Ludvig. 1968. *Philosophical Investigations*. Oxford: Basil Blackwell.

Wong, Daniel R., Sanchita Bhattacharya, and Atul J. Butte. 2019. "Prototype of Running Clinical Trials in an Untrustworthy Environment Using Blockchain". *Nature Communications* 10, no.1: 917. https://doi.org/10.1038/s41467-019-08874-y

Wood, Gavin. 2019. *Ethereum: A Secure Decentralized Generalized Transaction Ledger.* Byzantium version 3e36772.

Wu, Haoyan, Zhijie Li, Brian King, Zina Ben Miled, John Wassick, and Jeffrey Tazelaar, J. 2017. "A Distributed Ledger for Supply Chain Physical Distribution Visibility." *Information* 8, no.4: 137. https://doi.org/10.3390/info8040137

Xu, Li Da, Yang Lu, and Ling Li. 2021. "Embedding Blockchain Technology Into IoT for Security: A Survey". *IEEE Internet of Things Journal* 8, no.13, 10452–10473. https://doi.org/10.1109/JIOT.2021.3060508

Yang, Jian, Zhihui Lu, and Jie Wu. 2018. "Smart-Toy-Edge-Computing-Oriented Data Exchange Based on Blockchain". *Journal of Systems Architecture* 87: 36–48. https://doi.org/10.1016/j.sysarc.2018.05.001

Zhang, Peng, Michael A. Walker, Jules White, Douglas C. Schmidt, and Gunther Lenz. 2017. "Metrics for As-

sessing Blockchain-Based Healthcare Decentralized Apps". *2017 IEEE 19th International Conference on E-Health Networking, Applications and Services (Healthcom) 12-15 October 2017 Dalian,* China 1–4. https://doi.org/10.1109/HealthCom.2017.8210842
Zhu, Yanchao, Zhao Zhang, Cheqing Jin, Aoying Zhou, Gang Qin, and Yingjie Yang. 2020. "Towards Rich Qery Blockchain Database". In *Proceedings of the 29th ACM International Conference on Information & Knowledge Management* 19-23 October 2020 virtual, Ireland 3497–3500. https://doi.org/10.1145/3340531.3417424

Appendix 1
The list of definitions extracted and analyzed

Publication	**Definition**
(MacDonald et al. 2016)	A technology of decentralization and is therefore better understood as a new institutional technology for coordinating people—i.e., for making economic transactions—which then competes with firms and markets.
(Hazard et al. 2016)	A shared, auditable platform with formalized and unbreakable rules about how transactions must take place
(Ducas and Wilner 2017)	A digital distributed ledger used to record and share information throughout a peer-to-peer network
(Mackey and Nayyar 2017)	A secure distributed digital ledger (i.e. simultaneously shared across multiple users/locations and not stored in a single location) made up of 'blocks' of continuous transaction information
(Zhang et al. 2017)	A decentralized, trustless protocol that combines transparency, immutability, and consensus properties to enable secure, pseudo-anonymous transactions.
(Wu et al. 2017)	A distributed public database (ledger) that contains a continuously growing list of transactions which are organized in blocks and secured from tampering
(Bocek et al. 2017)	An infrastructure for smart contracts that can operate in a fully autonomous and decentralized manner.
(Dai and Vasarhelyi 2017)	A new type of database that has the potential to either play the role of the accounting module in an ERP or be used in conjunction with the existing accounting information system.
(Patel 2018)	A data structure consisting of an ordered sequence of batched entries termed blocks. The ordering of these blocks is established by storing a cryptographic hash of the immediate prior record within each block
(Li et al. 2018)	A distributed database system, it also can be regarded as a number of nodes jointly maintained by the Distributed Ledger Technology (DLT).
(Reyna et al. 2018)	The mechanism that allows transactions to be verified by a group of unreliable actors. It provides a distributed, immutable, transparent, secure and auditable ledger.
(Cheng et al. 2018)	A public ledger for an open and distributive community that composed of a large amount of peer-to-peer computers (and users) to record and share information in blocks without relying on a centralized server for activity coordination.
(Truby 2018)	A type of distributed ledger, comprised of digital records of transactions or assets, accessible to and trusted by all participants running the same protocol
(Alharby and van Moorsel 2018)	A distributed database that records all transactions that have ever occurred in the blockchain network
(Hammi et al. 2018)	A distributed database (ledger) that maintains a permanent and tamper-proof record of transactional data.
(Dagher et al. 2018)	An append-only data structure that functions as a distributed ledger.

Publication	Definition
(Savelyev 2018)	A type of distributed ledger in which value exchange transactions are sequentially grouped into blocks. Each block is chained to the previous one and immutably recorded across a peer-to-peer network, using cryptographic trust and assurance mechanisms.
(Yang et al. 2018)	A public ledger, in which all committed transactions are stored in a list (or a chain). This chain continuously grows when the new transactions have been confirmed.
(Banerjee et al. 2018)	A distributed database that keeps track of all transactions. Since all participating devices maintain the same records, unless an adversary manages to compromise the majority of devices, the integrity of the records will be assured.
(Glaser 2017)	A distributed, transactional database. Globally distributed nodes are linked by a peer-to-peer (P2P) communication network with its own layer of protocol messages for node communication and peer discovery
(Minoli and Occhiogrosso 2018)	A cryptographically-linked list of blocks created by nodes, where each block has a header, the relevant transaction data to be protected, and ancillary security metadata (e.g., creator identity, signature, last block number, and so on.).
(Khan and Salah 2018)	A decentralized, distributed, shared, and immutable database ledger that stores registry of assets and transactions across a peer-to-peer (P2P) network.
(Kleinaki et al. 2018)	A distributed, incorruptible transaction management technology without one single trusted party.
(Önder and Treiblmaier 2018)	A distributed database that is made up of a list of transaction bundles called blocks that are attached to each other.
(Chen 2018)	A distributed ledger that records and secures transactions in a peer-to-peer network.
(Galvez et al. 2018)	A distributed database of records in the form of encrypted “blocks” (smaller datasets), or a public ledger of all transactions or digital events that have been executed and shared among participating parties, and can be verified at any time in the future.
(Henry et al. 2018)	A distributed, append-only log of time-stamped records that is cryptographically protected from tampering and revision.
(Di Silvestre et al. 2018)	A distributed ledger of transactions, which is structured in blocks and stored in the network nodes.
(Gai et al. 2018)	A chain-enabled distributed ledger that provides tamper-resistant data storage functionality, such as transactions between parties.
(Esposito et al. 2018)	A technology able to build an open and distributed online database, which consists a list of data structures (also known as blocks) that are linked with each other (i.e. a block points to the following one, hence the name blockchain).
(Jiang et al. 2018)	A blockchain is an append-only data structure, to store a continuously growing list of transactions.
(Alzahrani and Bulusu 2018)	A public, distributed ledger that contains chained blocks, each of which is made up of several transactions
(Caro et al. 2018)	The distributed ledger technology underpinning cryptocurrencies such as Bitcoin, represent a new and innovative technological approach to realizing decentralized trustless systems.
(Cai 2018)	A distributed ledger which records information or transactions in a decentralized way.
(Casey et al. 2018)	A unique type of computerized ledger, one that relies on cryptographic techniques and new methods for consensus to capture and secure the data.
(Burchert et al. 2018)	A distributed append-only ordered list of transactions
(Tejal Shah and Shailak Jani 2018)	A digital, immutable, distributed ledger that chronologically records transactions in near real time.

Publication	Definition
(Danzi et al. 2018)	A concatenated list of blocks, stored in multiple copies by the nodes of the blockchain network.
(Feng et al. 2019)	An append-only database maintained by the nodes of a peer-to-peer (P2P) network.
(Andoni et al. 2019)	A digital data structure, a shared and distributed database that contains a continuously expanding log of transactions and their chronological order.
(Wong et al. 2019)	A new software development methodology involving a unique data structure
(Kuo et al. 2019)	A distributed ledger—write once and never erase
(Y. Wang et al. 2019)	An encoded digital ledger that is stored on multiple computers in a public or private network.
(Min 2019)	A peer-to-peer network of information technology that keeps records of digital asset transactions using distributed ledgers that are free from control by intermediaries such as banks and governments.
(Cichosz et al. 2019)	A distributed transaction/data ledger composed of blocks, with each block representing data linked to the previous block (layers of increasingly complex data secured by cryptographic hashing layers the data chronologically).
(Li et al. 2019)	A blockchain is a distributed data structure (ledger), which can hold any information (transactions, records etc.) that is simulated and shared between members of the network.
(Kamble et al. 2019)	A peer to peer transaction platform which doesn't need any third-party intermediary
(Qiu et al. 2019)	A list type data structure for public ledger which stores data elements is a block.
(Dwivedi et al. 2019)	A shared data structure responsible for storing all transactional history.
(Adytia et al. 2020)	A system that keeps track of transactions of its users in the form of ledgers on all the computers which are linked in a peer-to-peer network.
(Singh et al. 2020)	A decentralized, distributed, and public digital ledger that is utilized for saving the transaction in various nodes.
(Oliveira et al. 2020)	An asset database shared across a network of multiple sites, geographies or institutions, in which all nodes within the network hold an identical replica of the database.
(Bagay 2020)	A distributed database that is stored simultaneously by all users of the network.
(De Filippi et al. 2020)	A confidence machine that tries to displace trust in favor of confidence.
(L. Chen et al. 2020)	A distributed system that stores time ordered data in a continuously growing list of blocks
(Kouhizadeh et al. 2021)	Decentralized ledgers that contain transactions as data blocks; with blocks linked to their predecessors by a cryptographic pointer
(P. & Venkatesan 2021)	An open ledger that provides decentralization, transparency, immutability, and confidentiality
(Dotan et al. 2021)	A distributed system realizing a decentralized ledger or "database" with the property that once data is added, it cannot be removed or altered
(Saleh 2021)	A distributed ledger that records transactions across a network.
(Xu et al.2021)	A peer-to-peer (P2P) distributed ledger technology based on encryption algorithms and a shared database technology on the Internet.
(Muzammal et al. 2019)	A blockchain is a distributed and decentralized linked data structure for data storage and retrieval which also ensures that the data is resistant to any modification.

Appendix 2
List of the words used in the definitions with conjunctions, articles, etc. removed and repeating words changed to their root form

Terms		Freq	Terms		Freq
ACCESSIBLE	ACCESSIBLE	1	CONFIDENCE	CONFIDENCE	2
ACCOUNTING	ACCOUNTING	2	CONFIDENTIAL-ITY	CONFIDENTIAL-ITY	1
ACTIVITY	ACTIVITY	1	CONFIRMED	CONFIRMED	1
ACTORS	ACTORS	1	CONJUNCTION	CONJUNCTION	1
ADDED	ADDED	1	CONSENSUS	CONSENSUS	2
ADVERSARY	ADVERSARY	1	CONSISTING	CONSIST	2
ALGORITHMS	ALGORITHMS	1	CONSISTS		
ALLOWS	ALLOWS	1	CONTAIN	CONTAIN	4
ALTERED	ALTERED	1	CONTAINS		
AMOUNT	AMOUNT	1	CONTINUOUS	CONTINUOUS	6
ANCILLARY	ANCILLARY	1	CONTINUOUSLY		
ANONYMOUS	ANONYMOUS	1	CONTRACTS	CONTRACTS	1
APPEND	APPEND	5	CONTROL	CONTROL	1
APPROACH	APPROACH	1	COORDINATING	COORDINATING	1
ASSET	ASSET	4	COORDINATION	COORDINATION	1
ASSETS			COPIES	COPIES	1
ASSURANCE	ASSURANCE	1	CREATED	CREATE	1
ASSURED	ASSURED	1	CREATOR		
ATTACHED	ATTACHED	1	CRYPTOCURREN-CIES	CRYPTOCURREN-CIES	1
AUDITABLE	AUDITABLE	2	CRYPTOGRAPHIC	CRYPTOGRAPHY	7
AUTONOMOUS	AUTONOMOUS	1	CRYPTOGRAPH-ICALLY		
BANKS	BANKS	1	DATA	DATA	24
BATCHED	BATCHED	1	DATABASE	DATABASE	18
BITCOIN	BITCOIN	1	DATASETS	DATASETS	1
BLOCK	BLOCK	25	DECENTRALIZA-TION	DECENTRALIZE	11
BLOCKS			DECENTRALIZED		
BLOCKCHAIN	BLOCKCHAIN	3	DEVELOPMENT	DEVELOPMENT	1
BUILD	BUILD	1	DEVICES	DEVICES	2
BUNDLES	BUNDLES	1	DIGITAL	DIGITAL	9
CAPTURE	CAPTURE	1	DISCOVERY	DISCOVERY	1
CENTRALIZED	CENTRALIZED	1	DISPLACE	DISPLACE	1
CHAIN	CHAIN	5	DISTRIBUTED	DISTRIBUTE	41
CHAINED			DISTRIBUTIVE		
CHRONOLOGICAL	CHRONOLOGICAL	3	DLT	DLT	1
CHRONOLOGI-CALLY			ECONOMIC	ECONOMIC	1
COMBINES	COMBINES	1	EITHER	EITHER	1

Terms		**Freq**	**Terms**		**Freq**
COMMITTED	COMMITTED	1	ELEMENTS	ELEMENTS	1
COMMUNICATION	COMMUNICATION	2	ENABLE	ENABLE	2
COMMUNITY	COMMUNITY	1	ENABLED		
COMPETES	COMPETES	1	ENCODED	ENCODED	1
COMPLEX	COMPLEX	1	ENCRYPTED	ENCRYPT	2
COMPOSED	COMPOSED	2	ENCRYPTION		
COMPRISED	COMPRISED	1	ENSURES	ENSURES	1
COMPROMISE	COMPROMISE	1	ENTRIES	ENTRIES	1
COMPUTERIZED	COMPUTERIZED	1	ERASE	ERASE	1
COMPUTERS	COMPUTERS	3	ERP	ERP	1
CONCATENATED	CONCATENATED	1	ESTABLISHED	ESTABLISHED	1
EXISTING	EXISTING	1	EVENTS	EVENTS	1
EXPANDING	EXPANDING	1	EXCHANGE	EXCHANGE	1
FAVOR	FAVOR	1	EXECUTED	EXECUTED	1
FOLLOWING	FOLLOWING	1	LOCATION	LOCATION	2
FORMALIZED	FORMALIZED	1	LOCATIONS		
FULLY	FULLY	1	LOG	LOG	2
FUNCTIONALITY	FUNCTION	2	MACHINE	MACHINE	1
FUNCTIONS			MAINTAIN	MAINTAIN	4
FUTURE	FUTURE	1	MAINTAINED		
GEOGRAPHIES	GEOGRAPHIES	1	MAINTAINS		
GLOBALLY	GLOBALLY	1	MAJORITY	MAJORITY	1
GOVERNMENTS	GOVERNMENTS	1	MAKING	MAKING	1
GROUP	GROUP	2	MANAGEMENT	MANAGE	2
GROUPED			MANAGES		
GROWING	GROW	4	MANNER	MANNER	1
GROWS			MARKETS	MARKETS	1
HASH	HASH	2	MECHANISM	MECHANISM	2
HASHING			MECHANISMS		
HEADER	HEADER	1	MEMBERS	MEMBERS	1
HISTORY	HISTORY	1	MESSAGES	MESSAGES	1
HOLD	HOLD	2	METADATA	METADATA	1
IDENTICAL	IDENTICAL	1	METHODOLOGY	METHOD	2
IDENTITY	IDENTITY	1	METHODS		
IMMEDIATE	IMMEDIATE	1	MODIFICATION	MODIFICATION	1
IMMUTABILITY	IMMUTABLE	6	MODULE	MODULE	1
IMMUTABLE			MULTIPLE	MULTIPLE	4
IMMUTABLY			NETWORK	NETWORK	17
INCORRUPTIBLE	INCORRUPTIBLE	1	NEVER	NEVER	1
INCREASINGLY	INCREASINGLY	1	NODE	NODE	9
INFORMATION	INFORMATION	7	NODES		
INFRASTRUC-TURE	INFRASTRUC-TURE	1	OCCURRED	OCCURRED	1
INNOVATIVE	INNOVATIVE	1	ONCE	ONE	6

Terms		**Freq**	**Terms**		**Freq**
INSTITUTIONAL	INSTITUTION	2	ONE		
INSTITUTIONS			ONLINE	ONLINE	1
INTEGRITY	INTEGRITY	1	ONLY	ONLY	5
INTERMEDIARIES	INTERMEDIARY	2	OPEN	OPEN	3
INTERMEDIARY			OPERATE	OPERATE	1
INTERNET	INTERNET	1	ORDER	ORDER	5
INTO	INTO	1	ORDERED		
INVOLVING	INVOLVING	1	ORDERING		
JOINTLY	JOINTLY	1	ORGANIZED	ORGANIZED	1
KEEPS	KEEPS	3	OWN	OWN	1
KNOWN	KNOWN	1	PARTICIPANTS	PARTICIPATE	3
LAYER	LAYER	3	PARTICIPATING		
LAYERS			PARTIES	PARTY	4
LEDGER	LEDGER	34	PARTY		
LEDGERS			PEER	PEER	23
LINKED	LINKED	7	PEOPLE	PEOPLE	1
LIST	LIST	10	PERMANENT	PERMANENT	1
POINTER	POINT	2	PLACE	PLACE	1
POINTS			PLATFORM	PLATFORM	2
POTENTIAL	POTENTIAL	1	PLAY	PLAY	1
PREDECESSORS	PREDECESSORS	1	SINGLE	SINGLE	2
PREVIOUS	PREVIOUS	2	SITES	SITES	1
PRIOR	PRIOR	1	SMALLER	SMALLER	1
PRIVATE	PRIVATE	1	SMART	SMART	1
PROOF	PROOF	1	SOFTWARE	SOFTWARE	1
PROPERTIES	PROPERTY	2	STAMPED	STAMPED	1
PROPERTY			STORAGE	STORE	14
PROTECTED	PROTECTED	2	STORE		
PROTOCOL	PROTOCOL	3	STORED		
PROVIDES	PROVIDES	3	STORES		
PSEUDO	PSEUDO	1	STORING		
PUBLIC	PUBLIC	8	STRUCTURE	STRUCTURE	11
REAL	REAL	1	STRUCTURED		
REALIZING	REALIZING	2	STRUCTURES		
RECORD	RECORD	17	SYSTEM	SYSTEM	6
RECORDED			SYSTEMS		
RECORDS			TAKE	TAKE	1
REGARDED	REGARDED	1	TAMPER	TAMPER	4
REGISTRY	REGISTRY	1	TAMPERING		
RELEVANT	RELEVANT	1	TECHNIQUES	TECHNIQUES	1
RELIES	RELY	2	TECHNOLOGICAL	TECHNOLOGY	10
RELYING			TECHNOLOGY		
REMOVED	REMOVED	1	THIRD	THIRD	1
REPLICA	REPLICA	1	TIME	TIME	4

Terms		**Freq**	**Terms**		**Freq**
REPRESENT	REPRESENT	2	TRACK	TRACK	2
REPRESENTING			TRANSACTION	TRANSACTION	37
RESISTANT	RESISTANT	2	TRANSACTIONAL		
RESPONSIBLE	RESPONSIBLE	1	TRANSACTIONS		
RETRIEVAL	RETRIEVAL	1	TRANSPARENCY	TRANSPARENCY	2
REVISION	REVISION	1	TRANSPARENT	TRANSPARENT	1
ROLE	ROLE	2	TRIES	TRIES	1
RULES			TRUST	TRUST	6
RUNNING	RUNNING	1	TRUSTED		
SAME	SAME	2	TRUSTLESS		
SAVING	SAVING	1	TYPE	TYPE	5
SECURE	SECURE	8	UNIQUE	UNIQUE	2
SECURED			UNLESS	UNLESS	1
SECURES			UNRELIABLE	UNRELIABLE	1
SECURITY			USED	USE	8
SEQUENCE	SEQUENCE	1	USERS		
SEQUENTIALLY	SEQUENTIALLY	1	USING		
SERVER	SERVER	1	UTILIZED	UTILIZED	1
SEVERAL	SEVERAL	1	UNBREAKABLE	UNBREAKABLE	1
SHARE	SHARE	11	VERIFIED	VERIFIED	2
SHARED			SIMULTANEOUSLY	SIMULTANEOUSLY	2
SIGNATURE	SIGNATURE	1	UNDERPINNING	UNDERPINNING	1
SIMULATED	SIMULATED	1	UNDERSTOOD	UNDERSTOOD	1
VALUE	VALUE	1	VARIOUS	VARIOUS	1

Appendix 3
Table of concordance for four out of the five primary class terms

CASENO		KEYWORD	
1	A distributed public	database	(ledger) that contains a continuously growing list of transactions which
1	A distributed	database	of records in the form of encrypted "blocks" (smaller datasets), or a pu
1	A technology able to build an open and distributed online	database	, which consists a list of data structures (also known as blocks) that are
1	An append-only	database	maintained by the nodes of a peer-to-peer (P2P) network.
1	A digital data structure, a shared and distributed	database	that contains a continuously expanding log of transactions and their ch
1	An asset	database	shared across a network of multiple sites, geographies or institutions, in
1	s, in which all nodes within the network hold an identical replica of the	database	.
1	A distributed	database	that is stored simultaneously by all users of the network.
1	A distributed system realizing a decentralized ledger or "	database	" with the property that once data is added, it cannot be removed or
1	ributed ledger technology based on encryption algorithms and a shared	database	technology on the Internet.
1	A new type of	database	that has the potential to either play the role of the accounting module
1	A distributed	database	system, it also can be regarded as a number of nodes jointly maintainec
1	A distributed	database	that records all transactions that have ever occurred in the blockchain r
1	A distributed	database	(ledger) that maintains a permanent and tamper-proof record of transa
1	A distributed	database	that keeps track of all transactions. Since all participating devices mainta
1	A distributed, transactional	database	. Globally distributed nodes are linked by a peer-to-peer (P2P) commun
1	A decentralized, distributed, shared, and immutable	database	ledger that stores registry of assets and transactions across a peer-to-p
1	A distributed	database	that is made up of a list of transaction bundles called blocks that are at

CASENO		KEYWORD	
1	A	peer to peer	transaction platform which doesn't need any third-party intermediary
1	al distributed ledger used to record and share information throughout a	peer-to-peer	network
1	s users in the form of ledgers on all the computers which are linked in a	peer-to-peer	network.
1	A	peer-to-peer	(P2P) distributed ledger technology based on encryption algorithms an
1	n open and distributive community that composed of a large amount of	peer-to-peer	computers (and users) to record and share information in blocks withou
1	n block is chained to the previous one and immutably recorded across a	peer-to-peer	network, using cryptographic trust and assurance mechanisms.
1	outed, transactional database. Globally distributed nodes are linked by a	peer-to-peer	(P2P) communication network with its own layer of protocol messages
1	database ledger that stores registry of assets and transactions across a	peer-to-peer	(P2P) network.
1	A distributed ledger that records and secures transactions in a	peer-to-peer	network.
1	An append-only database maintained by the nodes of a	peer-to-peer	(P2P) network.
1	A	peer-to-peer	network of information technology that keeps records of digital asset t

CASENO		KEYWORD	
1	A data	structure	consisting of an ordered sequence of batched entries termed blocks. T
1	An append-only data	structure	that functions as a distributed ledger.
1	An append-only data	structure	, to store a continuously growing list of transactions.
1	A digital data	structure	, a shared and distributed database that contains a continuously expan
1	A new software development methodology involving a unique data	structure	
1	A distributed data	structure	(ledger), which can hold any information (transactions, records etc.) th
1	A list type data	structure	for public ledger which stores data elements is a block.
1	A shared data	structure	responsible for storing all transactional history.
1	A distributed and decentralized linked data	structure	for data storage and retrieval which also ensures that the data is resista

CASENO		KEYWORD	
1	s and not stored in a single location) made up of 'blocks' of continuous	transaction	information
1	blocks created by nodes, where each block has a header, the relevant	transaction	data to be protected, and ancillary security metadata (e.g., creator ide
1	A distributed, incorruptible	transaction	management technology without one single trusted party.
1	A distributed database that is made up of a list of	transaction	bundles called blocks that are attached to each other.
1	A distributed	transaction	/data ledger composed of blocks, with each block representing data lin
1	A peer to peer	transaction	platform which doesn't need any third-party intermediary
1	alized, distributed, and public digital ledger that is utilized for saving the	transaction	in various nodes.