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## **UNDERSTANDING THE FUTURE MARKET INFRASTRUCTURE DEVELOPMENT THROUGH THE USE OF TOKENIZED ASSETS**

### ***Abstract***

*The paper is dedicated to the discussion of the author's attempt to explain a trend in the future market infrastructure development through the use of tokenized assets.*

*The paper successively solves eight working tasks: a) clarify standard functions of the market infrastructure and roles of a market intermediary; b) outline the logic for developing a virtual market and place of a legal deal; c) clarify four mandatory components of a standard deal; d) distinguish the concept of "tokenized document" as a modern type of legally valid contract; e) distinguish entities and objects involved in a deal and essential conditions of a legally valid deal; f) subjectively assess the potential impact of tokenized assets on the renewal and development of the market infrastructure; g) outline new opportunities for regulating market relations using tokenized assets, which are consequences of properties and parameters of tokenized assets; h) summarize levels of formation of a new economic potential of tokenized assets for the market infrastructure development.*

*The author concludes that distributed ledger tools and especially the most promising type of distributed ledger virtual asset, such as a tokenized asset, can drive the market infrastructure modernization. It will be a new and additional means for addressing global wealth inequality using tokenized assets. Its "key" is to create new professional jobs in the ecosystems of decentralized information platforms. The most expected promising areas, especially widespread digital commerce, management of objects of intellectual property rights, agricultural sector at the level of micro and small farms, pave the way for significant, almost radical transformations in the composition, structure and number of participants in the market infrastructure and economic relations on the markets.*

*The main and fundamental technical means for this new market infrastructure organization are backed distributed ledger tokens or tokenized assets, namely tokenized contracts, tokenized resources and tokenized deals.*

*Based on the information and applied nature of tokenized assets and four standard components of a deal (contract, entities and objects involved as well as essential conditions of the contract), the*

*author proposed three types of tokenized assets based on the feature “original asset underlying the tokenized asset”, namely: (a) tokenized document, (b) tokenized resource and (c) tokenized deal. Together they universally cover all types of original (underlying) assets in legal civil and economic circulation in almost any country in the world. Having different functional purposes, these three types of tokenized assets along with a digital ecosystem of services potentially fulfill many functions of market intermediaries in the modern market infrastructure.*

**Keywords:** *tokenized asset; tokenization; market infrastructure; intermediary; distributed ledger token; tokenized contract; deal; tokenized resource.*

JEL: K10, K24, M15, O38

**General problem statement.** As is known, new digital technologies have a transformative effect on many areas of life and social institutions. In 10–15 years, the culture of consumption, leisure and communication may change significantly due to the simultaneous deep and wide penetration of “digits”. Focusing on the mass-market customer and profits, companies will change or supplement methods of doing business, delivery and inspection of goods, etc. Now there are numerous examples and realistic theories. One of the main areas with guaranteed significant transformations affected by “digits” is the market infrastructure. The future of numerous intermediaries performing really important functions is in question. Purely economic questions arise: how and to what extent will the number of intermediaries decrease and where will millions of private service and commercial intermediaries (individuals and small businesses) go after experiencing digital transformations? Time will soon allow answering these difficult questions.

The focus of this paper is to understand the future market infrastructure development through the use of tokenized assets. If tokenized assets are relatively new phenomena of recent years, it is not about the market infrastructure. It is a category with a thousand-year history that had a decisive influence on the historical development of humanity and all civilizations, including all modern ones.

**Analysis of the latest research.** The presence of a well-developed infrastructure is one of the very important conditions for the market functioning and efficiency of the market economy functioning directly depends on the infrastructure and level of its development. The infrastructure development level, in fact, determines the degree of the

market development and market relations in the country and greatly affects their efficiency. In this sense, it is appropriate to focus on the concept of economic category, such as “market infrastructure”.

The study of both infrastructure and market infrastructure as objects of scientific knowledge of economists goes back to the 17th and 18th centuries, respectively. The paper [9, p. 9] states: “The term “infrastructure” has been introduced for the first time to denote objects and structures ensuring normal functioning of armed forces and since the mid-20th century it has been widely used in economic and political literature”. Today, there are many papers devoted to both infrastructure and market infrastructure and including them in various theoretical and empirical constructions, especially the latest ones [20; 24]. At the same time, only a small part of them indicates the problem of differences in approaches to the infrastructure determination and its classification. Such almost single exceptions include the following papers [18; 21; 22; 35].

However, today the economic category of “market infrastructure” should be also considered in terms of technological innovations and digital culture [25; 32] since the future consequences of changes can be not only unexpected, but even shocking for its immediate participants. “Digits” have already changed the business model and participants in cross-border payments [29; 37] that are in fact typical market intermediaries on a global scale. “Digits”, namely virtual communities of the Web 3.0 format with metaverses, commercial digital platforms [38], cloud computing of big data and blockchain-based verification together change the culture of consumption [24] and human relations “vertically” [26] and “horizontally” [30]. We can continue this list of changes for a long time and at the same time, we should not be surprised by social changes since we are witnesses and participants in these changes. However, I think the main changes are still ahead: major changes are expected due to the joint and combined use of artificial intelligence and tokenization of assets and legal relations in the economy [4] and personal life.

***The aim and tasks of the paper.*** The aim of the paper is to theoretically substantiate ways of the future market infrastructure development through the use of tokenized assets in legal deals on a national and global scale. Achieving this research goal determined

solving a number of nested problems that explain the general logic and phasing of this research:

- 1) clarify standard functions of the market infrastructure and roles of a market intermediary;
- 2) outline the logic for developing a virtual market and place of a legal deal;
- 3) clarify four mandatory components of a standard deal;
- 4) distinguish the concept of “tokenized document” as a modern type of legally valid contract;
- 5) distinguish entities and objects involved in a deal and essential conditions of a legally valid deal;
- 6) subjectively assess the potential impact of tokenized assets on the renewal and development of the market infrastructure;
- 7) outline new opportunities for regulating market relations using tokenized assets, which are consequences of properties and parameters of tokenized assets;
- 8) summarize levels of formation of a new economic potential of tokenized assets for the market infrastructure development.

***Presentation of basic material.*** Before focusing further on the market infrastructure, let us summarize the definition of the term “infrastructure”. A comparison of constructive ideas that reveal the economic essence of the term “infrastructure” allows distinguishing three main groups of definitions: 1) infrastructure is a set of conditions that ensure favorable development of economic sectors and satisfy needs of the public; 2) infrastructure is a service system that provides services for production and the public; 3) infrastructure is a set of interconnected service institutes necessary for maintenance and normal development of the territorial economy.

Below we will focus on the economic category of “market infrastructure”. As is known, the main market infrastructure purpose is to create stable conditions for bringing supply and demand together on the market by providing special, usually, paid and professional services, and, accordingly, the main market infrastructure products are services and works.

The main market infrastructure functions are as follows: “1) risk reduction through the use of various types of insurance, audit activities, consulting services; 2) turnover acceleration through the use of factoring, brokerage and finder services, quality recruitment of employees and contractors, use of improved special means of communication; 3) enterprise development through the expansion of rent and leasing, issuance of securities, improvement of training and retraining of employees in the fields of management and reengineering, further growth of small and medium-sized enterprises; 4) promotion of goods and services to consumers using advertising and other marketing means” [17, p. 4]. Therefore, the main market infrastructure functions are to provide connection between elements of the market system, which include objects and entities involved in it, and to organize and regulate the interaction of elements of this system. As a result, implementation of these functions ensures optimization of the flow of goods and money. The infrastructure, being a “market intermediary”, ensures correspondence between the needs for goods and services and production ability to satisfy these needs [1].

The main market infrastructure functions are performed not through individual, but through simultaneous and joint (even coordinated between participants) activities of numerous participants in the market infrastructure. For example, “accumulation and distribution of free finance on the market are the main tasks of financial intermediaries. The speed and efficiency of mobilization of financial resources depend on the quality and cost of services provided by banks, international financial institutions, donor organizations, stock and currency exchanges, investment funds and companies, credit, insurance and guarantee institutions. At the same time, the level of operation of the market infrastructure organizational and technical subsystem, individual elements of which ensure general coordination of market relations, other elements provide a mechanism for accounting and control, directly affects the efficiency of decision-making regarding the financing of market entities” [17].

As is known, *intermediaries* represent one of central and vital elements of the market infrastructure. Below we will consider this economic and social institution and

phenomenon in more detail, briefly presenting conclusions from basic theories and modern views that:

1) on the one hand, support intermediaries;

2) on the other hand, note the high cost of intermediaries, in particular, conclusions from Ronald Coase theorem and modern business models that in practice easily prove it. In the future, it will allow drawing conclusions about a new way of performing functions of an intermediary in the modern market infrastructure of the 21st century with regard to digital technologies and blockchain technology.

What is the role of the intermediary concept in traditional economic theory? Standard economic theory is based on the idea of a conditional “auctioneer” with the main function of determining a fair price on the market. This macrohypothesis is based on the model of “pure and perfect competition”. Natural skepticism about complete and symmetrical information allowed rethinking the role of market intermediaries in a new way and their appearance in general, when opportunities for productive exchange were exhausted. It is possible to justify new players seeking to use the market advantages for personal gain and to participate in strategic activities using these configurations, as noted by A. Smith [34]. Following this “prototype”, development of the role of intermediaries became the starting point for marketing development as a major discipline that differed from typical economics. More than 100 years ago, the paper [33] analyzed presence and growing number of intermediaries. Focusing on the organization of market distribution, the author of the paper, A. Shaw, determined general functions of an intermediary: sharing risks, transporting goods, financing transactions, selling, assembling and sorting. As a result of the development of functional intermediaries (insurance companies, direct transportation companies, banks), A. Shaw paid more attention to the sales function (communicating ideas about goods) as well as assembly and sorting function, analyzing advantages of contacting (or refusing) an intermediary.

Below we will consider the phenomenon of “market intermediary” in terms of the well-known Ronald Coase theorem [23]. The theorem reveals economic content of property rights: the more precisely property rights are defined, the more external costs are transformed into internal ones. Under the condition of positive transaction costs (that is,

costs during the conclusion and execution of contracts), optimal market equilibrium is not provided, another suboptimal equilibrium is provided. The challenge will be whether transaction costs can be reduced by creating institutions and rules to make the economy more efficient. “The digital economy creates a fundamentally new environment for transaction costs. In fact, they decrease multiply...” [2]. It is possible to explain human relations in society in a different way using Coase theorem. Since all humans have limitations in one sense or another, they try to act rationally, bypassing rules and behaving opportunistically that results in certain “tensions” or “frictional forces” [2]. Their reasons are mutual distrust and an attempt to deviate from rules. Therefore, “human” dimension and meaning of Coase theorem are as follows: a suboptimal equilibrium will always be provided with positive transaction costs. That is, it means that the world is not completely universal or ideal, but there is a lot of diversity.

The rate of public transaction costs can be estimated based on the research by Americans J. Wallis and D. North based on data for 1870–1970, taking into account fields of wholesale and retail trade, finance and insurance, and real estate transactions in the USA for the first time [36]. This century spanned three industrial revolutions that, certainly, reduced technological costs and created new jobs. The main conclusion is that even as US production became cheaper, society became more expensive because increasingly complex structures operated in the economy with more educated people demanding increased incomes. Although the total costs (especially the cost of production) for the producer have been constantly reduced, the share of transaction costs has been constantly increasing, and in the 1970s it slightly exceeded half of all costs. The half of all costs includes social friction costs: professional services and management “superstructures”, various intermediaries [2]. Modern practical examples of reducing these frictional forces are “flat” business models of the American Uber and Ukrainian Uklon taxi services, etc. This is one of examples of the spread of simpler and no less effective mechanisms for organizing economic and social relations. Other similar examples of simplification (in the same plane) can be practices of keeping joint records of certain benefits (distributed ledger technologies) and reviewing the way of providing

a unique identifier to any tangible and intangible assets (tokenized assets [31]), using “right to right”.

The global economic system is constantly expanding. Globalization results in the rapid and multidirectional development of the market infrastructure based on information flows. Thanks to the development and integration of various digital technologies, the modern market system in terms of consumer perception has become so simplified that the consumer can make the necessary purchases without leaving home. New technologies, healthy competition, struggle for the client, optimization of combining the producer with the consumer and new business models based on them contribute to the active market infrastructure development and evolutionary processes in the global economy, in particular, vertical integration of markets and emergence of such a concept as “a virtual market” (Figure 1).

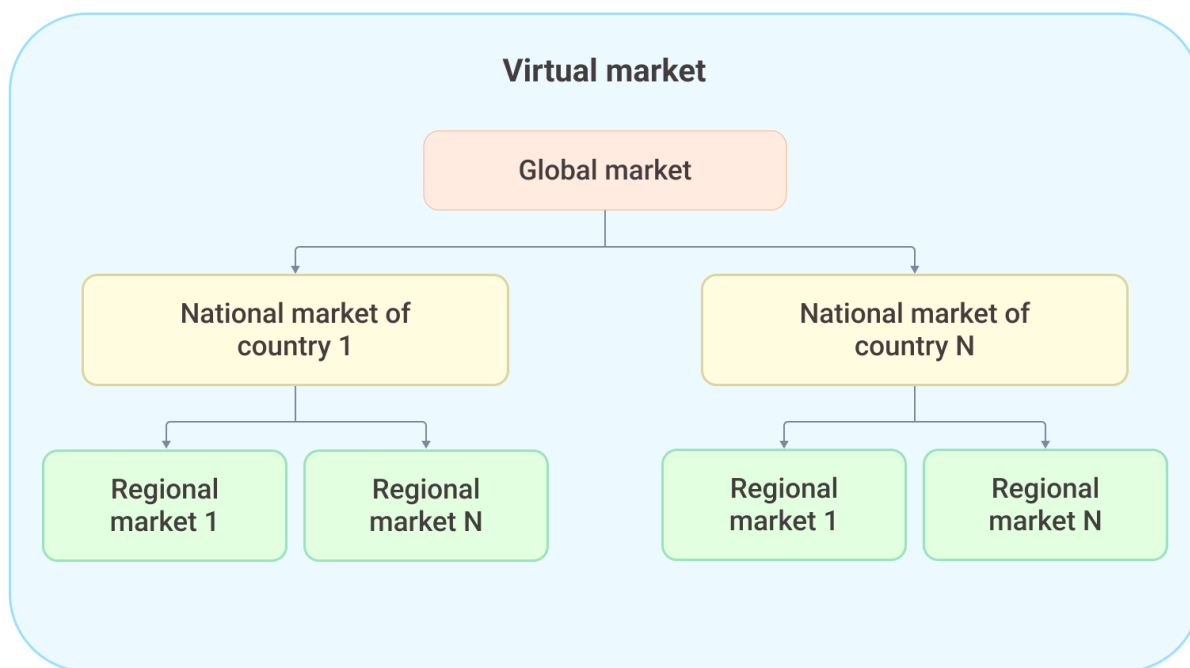


Fig. 1. An example of vertical integration of geographic markets and their coverage by a common virtual market without administrative borders

\* Source: author’s development.

The virtual market has been formed due to the rapid and deep penetration of the Internet. Its further development has been due to the expansion of elements of the market infrastructure thanks to numerous information (digital) e-commerce platforms (for

example, Amazon, eBay, Rakuten, Taobao) that enable much faster “economic communication” and exchange between the producer, supplier (seller), carrier, insurant, creditor and end consumer. The transition of business entities to the virtual space allowed significantly optimizing costs in the “producer — consumer” supply chain [3]. According to this model of the market infrastructure, relations between economic agents are more optimal in terms of time/cost/benefit criteria compared to all previous models [15].

Information platforms are also modern elements of the market infrastructure and, in fact, are also market intermediaries: they create direct conditions for immediate economic communication in terms of simple and safe conclusion of agreements (contracts) online. There are many completely different centralized information platforms in the field of e-commerce: Uber, Amazon Marketplace, Airbnb, Uklon, Bolt, Groupon, eBay, OLX, AUTO.RIA, Rozetka and others. They have already significantly improved the composition and all business processes in the market infrastructure compared to the state that existed, for example, 20 years ago. Using them, without leaving home or even without taking out the smartphone, any conscious person can order lunch, pay for gas or tuition, buy tickets, book a gym membership, etc.

It is important to note that all actual results of market relations between economic agents are nothing more than legal deals, that is, they are legitimate volitional actions, and this position prevails in the legal literature [11]. If they are deals, they shall have entities and objects. Unfortunately, the technological specificity of the above centralized information platforms with one hierarchically higher decision-making party cannot fully:

- firstly, guarantee the verification of entities and objects, and sometimes even reliable identification of a person;

- secondly, organizationally and technologically ensure integration of data of their registers (electronic databases, records) with similar registers of other platforms with other ambitious owners, even if their use objects or entities coincide. It is a very important economic and managerial limitation in the context of modernizing the market infrastructure.

For example, a typical deal for buying/selling goods through the Ukrainian online platform OLX is actually at the level of trust relations between OLX participants because

the internal OLX policy does not require final verification of entities and does not guarantee strict correspondence of objects (physical and consumer conditions of even new goods). Accordingly, the parties rely on (a) the integrity of each other, (b) rating and organizational sanctions of the OLX platform against the possible infringer and (c) the right to return inspected and undamaged goods according to the platform requirements and the national consumer protection law. However, even in this case, the risk of time lost by the buyer for unsuccessful agreement (deal) is not taken into account, although time is the most valuable economic and vital resource. Another example is ordering a taxi service through the well-known Bolt online service identifying the consumer only by a phone number that is not legally related to a natural person (customer) and does not result in legal liability, for example, in case of illegal actions of the client during a taxi trip.

That is, as it follows from these simple examples, legal relations between economic entities in popular information platforms are actually semi-anonymous and partly trustful, which results in legal risks at least for both parties. Therefore, in such cases, state guarantees of compliance with legal rights of participating parties cannot always be applied since they have not been identified and all parties to relations have taken this potential risk consciously. Moreover, organizational and technological features of most, if not all, private centralized platforms in the field of e-commerce cannot guarantee constant and reliable information for the court, in particular, information about entities and objects involved in a deal or even conditions of the contract, which this deal is based on. It is possible due to the constant risk of intervention by a “super administrator”, such as an owner of the platform or an owner of the data register that has not been at least minimally integrated with other private and public registers. That is, valid information in centralized information platforms cannot be guaranteed technologically.

Unlike centralized platforms, decentralized information platforms (*hereinafter referred to as “DIPs”*) are based on the distributed ledger technology (blockchain) [6] — an information system, accounting objects of which are distributed ledger tokens. At the same time, accounting objects of the decentralized information platform are tokenized assets that are distributed ledger tokens by their technological nature. As is known, the key feature of the distributed ledger technology is that it can guarantee constant data or

chronological information about all changes made to the data at the technological level. Therefore, with organizational and technological support for identifying objects and verifying entities according to international KYC (*know your customer (client)*) standards, the decentralized information platform allows reliably ensuring valid data and guaranteeing constant entities and objects within a specific deal using a tokenized asset that is purely technologically and legally tied to the deal. It is essential during legal proceedings, for example, disputes between parties — platform users.

Accordingly, based on the fact that a typical decentralized information platform is a hardware and software complex, which technologically and legally creates and maintains a secure environment for deals using tokenized assets, minimum expected consequences for the future market infrastructure renewal based on the use of tokenized assets can be recorded:

- 1) tokenized asset is derived from the original asset that is determined by a legal connection with a specific deal manifested in mutual rights and obligations between the original asset owner and the tokenized asset owner [7];

- 2) decentralized information platforms can technologically guarantee identification and constant entities and objects involved in legal relations using a tokenized asset;

- 3) actually becoming the newest part of the market infrastructure, decentralized information platforms provide the market infrastructure with new opportunities and qualities;

- 4) tokenized assets as the only technologically possible accounting objects in DIPs are essentially tools for the market infrastructure development.

Thus, in aggregate, it potentially means that tokenized assets are new and more progressive and reliable methods of a legally valid deal.

The author's thematic publication [7] of 2021 has substantiated that, depending on the goals of creating a tokenized asset and tokenization object, three components of a tokenized asset can be distinguished: (1) technological, (2) legal and (3) information and applied component. The first two components have been briefly described in this publication. As for the third — information and applied — component since a tokenized

asset is derived from the original asset [7] and it is determined by a legal connection with a specific deal, and all results of implemented market relations between economic agents are legally nothing more than deals, it is appropriate to reveal the information and applied nature of a tokenized asset in terms of a more complete understanding of the deal.

Thus, according to Article 202 of the Civil Code of Ukraine [19], “a deal is an action of a person aimed at acquiring, changing or terminating civil rights and obligations”. One of grounds for civil rights and obligations includes contracts. “A contract is an agreement between two or more parties aimed at establishing, changing or terminating civil rights and obligations... Essential conditions of the contract are conditions on the contract subject, conditions determined by law as essential or necessary for such contracts and all those conditions, on which an agreement shall be reached at the request of at least one of the parties” [19]. Conditions on the contract subject shall define the object (property, works, services, etc.), in relation to which civil rights and obligations are acquired, changed or terminated [10]. Also, essential conditions may include the method and tools that allow acquiring, changing or terminating civil rights and obligations in relation to the object involved in legal relations. Thus, in the context of the information and applied nature of a tokenized asset, four components of a deal can be distinguished:

- 1) contract is a basis for civil rights and obligations;
- 2) entities are parties to the contract (deal);
- 3) objects include property (works, services, etc.), in relation to which civil rights and obligations are acquired, changed or terminated;
- 4) essential conditions are determined as individual conditions of the contract, in particular, the method and tools that allow acquiring, changing or terminating civil rights and obligations within the contract (Figure 2).

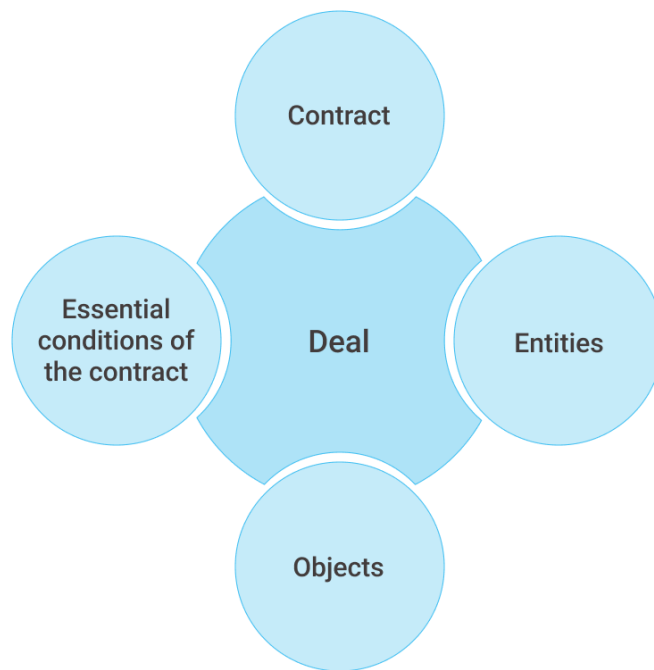


Fig. 2. Typical components of a deal

\* Source: author's development.

The next step is to consider possible tokenization of the specified deal components, that is:

- creation of applied (or utilitarian) tokenized assets and
- determination of their characteristics and scope of application with further systematization of received information for determining types of tokenized assets based on their information and applied nature.

The first component of a deal is *a contract*. According to Part 1 of Article 205 of the Civil Code of Ukraine, a contract form is oral and written. In particular, if the parties agreed to conclude a contract using information and communication systems, it is considered as a contract in writing. Since the oral contract is not expressed and concluded materially, only the written form will be considered within our research. The written contract, in particular, concluded using information and communication systems, is essentially a document. The Law of Ukraine “On Information” [14] determines that a document is “a physical medium containing information with the main functions of its preservation and transmission in time and space”. The Law of Ukraine “On Libraries and

Librarianship” determines a document as “a material form of receiving, storing, using and distributing information recorded on paper, magnetic, film, photographic film, optical disk or other media” [12]. According to the Regulation of the European Parliament and the Council (EU) No. 1303/2013 dated December 17, 2013 [16], the concept of “document” means a paper or electronic information medium.

A logical analysis of these definitions indicates that the key criterion for the concept of “document” is a physical information medium. According to Article 200 of the Civil Code of Ukraine, “information includes any information and/or data that can be stored on physical media or displayed in electronic form”. Thus, documents can include written contracts, acts, identity documents, diplomas, certificates, certifications, tickets, scientific papers, works, etc. In terms of the applied aspect, the document use implies such features and attributes of the documented information circulation system as reliable, constant and valid information. It has been shown above that these attributes are not guaranteed (currently in popular e-commerce platforms) in full when using centralized information systems and corresponding private registers.

The main properties of the distributed ledger technology as an information technology are technological guarantees of transparency, security and invariability of entered information. Therefore, creation of tokenized assets as tools for technological confirmation and guaranteeing valid and constant information in documents is an applied form of using tokenized assets and determines the need to separate such tokenized assets as a specific type — a tokenized document. Accordingly, the concept of “tokenized asset” includes tokenized contracts, work completion certificates, certificates of persons or actions, etc.

“A tokenized document” is a type of tokenized asset, the original asset of which is a document. It is proposed to understand “a document” as the definition provided in the national legislation of a particular state. It means that:

- 1) tokenized document is a digital document registered in a decentralized information platform using a distributed ledger token transaction;

- 2) applied value of this tokenized asset lies in technological guarantees of the document validity.

Therefore, the tokenized document is widely used, in particular:

- verification of documents, such as a report, diploma, identity card, certificate, etc.;
- technical possibility to modernize electronic document flow and further organizationally support its global scaling by means of a decentralized information platform;
- technical possibility to organize voting systems;
- submitting and signing petitions to authorities;
- unambiguous and legal identification of the author of the created document or object of intellectual property rights, etc.

In addition, a tokenized document can store information about all contract signatories even if this contract is public since signing is automatically registered using a distributed ledger token transaction. That is, a tokenized document, the original asset of which is an offer, can store information about all acceptances and directly about acceptors. This property is legally and economically significant since an offer (for example, a public offer) is still the most common type of contracts (agreements) that regulates legal relations between individuals in the digital environment: information platforms, online services, etc. That is, regardless of contract types that can be used within tokenized documents, their entities will always be reliably and fully identified.

The second component of a deal includes *entities involved in it* (see Figure 2). It is determined that entities involved in legal relations using a tokenized asset represent one of the main conditions for legal circulation of tokenized assets as tools for financial and management property accounting in information platforms. At the same time, entities involved in legal relations using a tokenized asset shall be reliably identified and verified according to international KYC standards. The Law of Ukraine “On the Unified State Demographic Register and Documents Confirming the Citizenship of Ukraine, Identity or Special Status” establishes the following definitions:

- verification is a comparison of data (parameters), including biometric data, to establish a person identity with documents or information from the Unified State Demographic Register for confirming their identity;

- identification of a person is an identity check by comparing provided data (parameters), including biometric data, with available information about the person in registers, card files, databases, etc. [13].

That is, a person is identified through the verification. Given that all relations between users of information platforms are in the digital environment, it is appropriate to talk about digital identity. In March 2020, the Financial Action Task Force (FATF) published the Guidance on Digital Identity [27]. According to this Guidance, the main elements of digital identity are:

- 1) verification and confirmation of identity, registration. It includes: (a) obtaining attributes (name, date of birth, ID number, etc.) and certificates confirming these attributes and (b) verifying and confirming authenticity of identity documents and identifying them with a specific authenticated person;

- 2) binding that involves release of credentials that are purely related to the person (i.e. authenticators), who owns/controls those credentials, to the authenticated person;

- 3) authentication that involves establishing that only the applicant owns and controls the related credentials [27].

In other words, verification and identification of a person in the digital environment are aimed at establishing a one-to-one correspondence between a person's account and the person having it. Each account has its own unique digital identifier that is used to authenticate a person in the digital environment. In addition, the Guidance on Digital Identity [27] provides that electronic databases, including blockchain-based distributed ledgers, can be used to obtain, validate, store and/or manage identity cards in digital identity systems. That is, as early as 2020, the FATF predicted reasonable feasibility of using the distributed ledger technology in digital identity systems.

Credentials of a user of the information platform as the digital environment contained in the account include data uniquely identifying him/her as a person, in particular:

- full name;
- date of birth;
- gender;

- citizenship;
- national ID documents;
- address information, etc.

That is, data can also be defined as information stored in electronic form on a physical medium — in a digital account. Thus, in fact, an account is a document that has its own unique digital identifier and its information is certified by a certain person — a verifier.

Since the account in the information platform can be defined as a document by its essential features, the account of any verified decentralized information platform user can be a tokenized document.

In view of the legal as well as information and applied nature of the tokenized asset substantiated above, continued logical chain “account in the DIP → tokenized document → protected deal” results in the following important conclusions for practical organization of relations in the market infrastructure renewed using tokenized assets:

1. Since a user creates an account in the DIP and independently fills it in by entering all credentials required for further verification and identification, provided that these credentials really belong to him/her, this user is the author of this document (account). Accordingly, after verification as per international KYC standards, this document is automatically signed by the person performing verification (verifier) using a distributed ledger token transaction.

2. It means that the verifier, being an identified user of the decentralized platform, conducts a deal for verifying another user’s account with registration of this deal using a special distributed ledger token. As a result, a tokenized document (account) is created. Its author and owner is the user. Only the user has access to the information in this tokenized document (account) and, if necessary, can provide it to other users of the decentralized information platform, for example, to establish and identify the contract parties before conducting a deal.

3. The tokenized document use in the context of the account of decentralized information platform users allows not only identifying entities involved in deals between

these users, but also ensuring technical compliance with the sovereign identity principle in decentralized information platforms.

Furthermore, the third component of a deal includes *objects involved in it* (see Figure 2). The object involved in legal relations is property (works, services, etc.), in relation to which civil rights and obligations are acquired, changed or terminated. At the same time, identification of the object involved in legal relations is one of essential conditions for a legal deal.

The deal object can be property, services or works. Each of these categories can be identified by a group of features, attributes and properties. That is, each object has specific characteristics and specifications that can be described and certified by its owner (property owner or service/work provider). Features, attributes and properties of the object can be described and certified in electronic form. As a result, there is a certain unique *information resource* that includes a complete description and necessary information for unambiguous identification of the object involved in legal relations and can include:

- digital copies of documents proving ownership;
- photographic or video materials;
- links to state/private registers;
- software solutions;
- various digital files, etc.

This set of data allows uniquely identifying the object involved in legal relations or can include it, if this object is property in digital form (for example, a scientific paper, a video recording, an audio file, a website, a computer program, etc.). Moreover, this set of data is the only information resource, the content of which can be uniquely recorded and identified using a distributed ledger token transaction. As a result, *a tokenized object involved in legal relations* is created, that is, a set of digital data that includes all necessary and relevant information about the deal object and is registered in the DIP using a distributed ledger token transaction.

Thus, this tokenized asset allows identifying the object involved in legal relations and includes valid (authenticated) and constant information about it. This type of

tokenized asset can also be attributed to generalizing and quite universal types (classes) of tokenized resource since:

1) its original asset is a set of digital information about the deal object or directly digital deal object, that is, in fact, it is an information resource;

2) accounting environment of this tokenized asset is exclusively a decentralized information platform with users verified according to KYC standards (that is, reliability of entities is completely ensured).

The last argument points to an important practical component of a tokenized resource — technically possible reliable management of access to its content and establishment of algorithmic rules for segregation (clear distribution) of conditions for access.

As mentioned above, a tokenized resource original asset can directly be the object involved in legal relations, which is property in digital form. This property can include not only photographic, video or audio files, but also computer programs, websites, online services, software modules, etc. That is, practical relevance of a tokenized resource as a tool for the market infrastructure development can be quite significant since it allows talking about that tokenized assets and decentralized information platforms can be foundation for forming and developing the Web 3.0 industry with the maximum possible user identification and verification of their rights, roles and statuses in digital platforms, for example, in popular metauniverses. In particular, examples of practical tokenized resource use include:

- creation of scientometric and bibliographic databases with an automated and transparent system of citing indexed authors;
- internal networks (intranet) of identified users with different access (admission) rights;
- global decentralized management of objects of intellectual property rights within blockchain platforms, etc.

The fourth component of a deal includes *essential conditions of the contract* (see Figure 2), that is, determining individual conditions of the contract, in particular, the

method and tools using which civil rights and obligations within the contract are acquired, changed or terminated.

Given the properties and capabilities of the distributed ledger technology, a distributed ledger token can be a tool for managing rights under the contract and the method of acquiring, changing or terminating civil rights and obligations within the contract in this case will be a distributed ledger token transaction. In fact, it is about tokenization of essential conditions of the contract. Thus, *a deal organization model* can be offered under the above essential conditions using a tokenized asset and it is, in fact, a tokenized deal model. In general, this model is given in Figure 3 below.

The deal tokenization requires all deal components that can be certified in the DIP and their properties correspond to properties of tokenized assets that can circulate in the DIP.

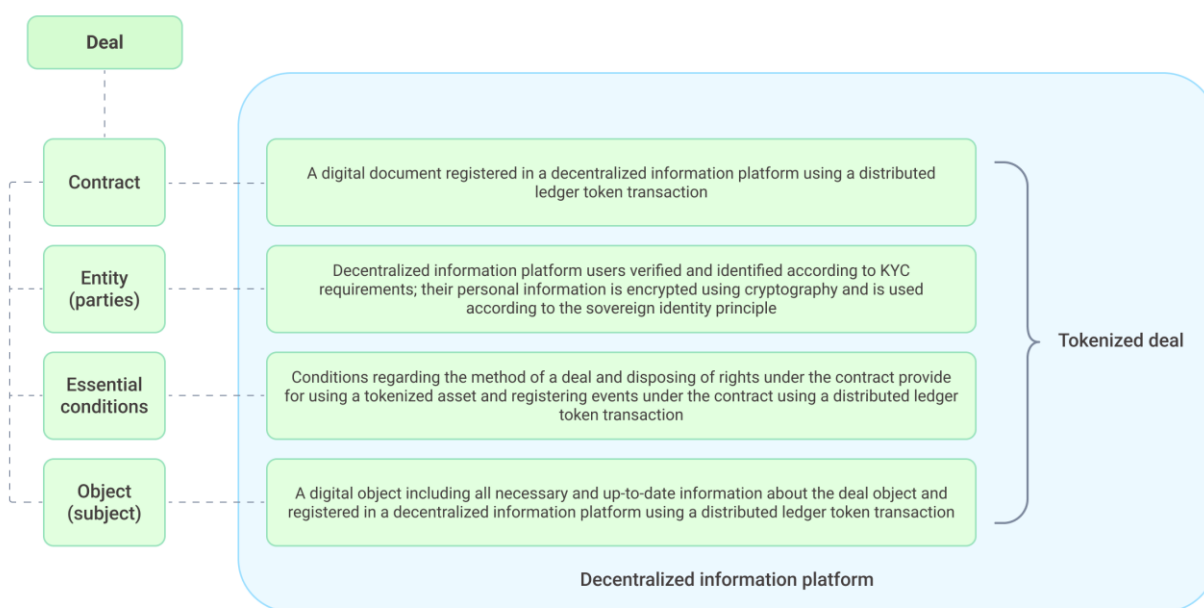


Fig. 3. Interrelationship of a tokenized deal and its components

\* Source: author's development.

Thus, to create a tokenized deal it is necessary to:

1) determine an object involved in legal relations and create a tokenized object involved in legal relations based on it. This tokenized object involved in legal relations shall include all necessary valid digital information about property (works, services),

being the object involved in legal relations, which is registered in a decentralized information platform using a distributed ledger token transaction;

2) determine entities involved in a deal from among verified and identified users of the decentralized information platform;

3) create a tokenized contract that specifies a tokenized object involved in legal relations and determines entities involved in a deal from among users of the decentralized information platform;

4) determine in essential conditions of a tokenized contract that a tool for disposing of rights under the contract will be a distributed ledger token and method of acquiring, changing and terminating civil rights and obligations within the contract will be a distributed ledger token transaction.

Therefore, a tokenized deal can be separated into a certain type of tokenized asset. Its essential features include:

1) tokenized asset. The corresponding tokenized asset allows disposing of rights regarding property (works, services) using a distributed ledger token transaction. The tokenized asset is clearly linked to the original asset that legally ensures civil circulation of tokenized assets;

2) reliable and cryptographically protected information about property (works, services), i.e. objects involved in a deal. This information is included in a tokenized object involved in legal relations and is registered using a distributed ledger token;

3) legally significant conditions of a tokenized contract. Rules and clear conditions for disposing of this property (works, services) are determined in the tokenized contract that also includes uniquely identified entities involved in this deal from among the DIP users and is registered using a distributed ledger token transaction (Figure 4).

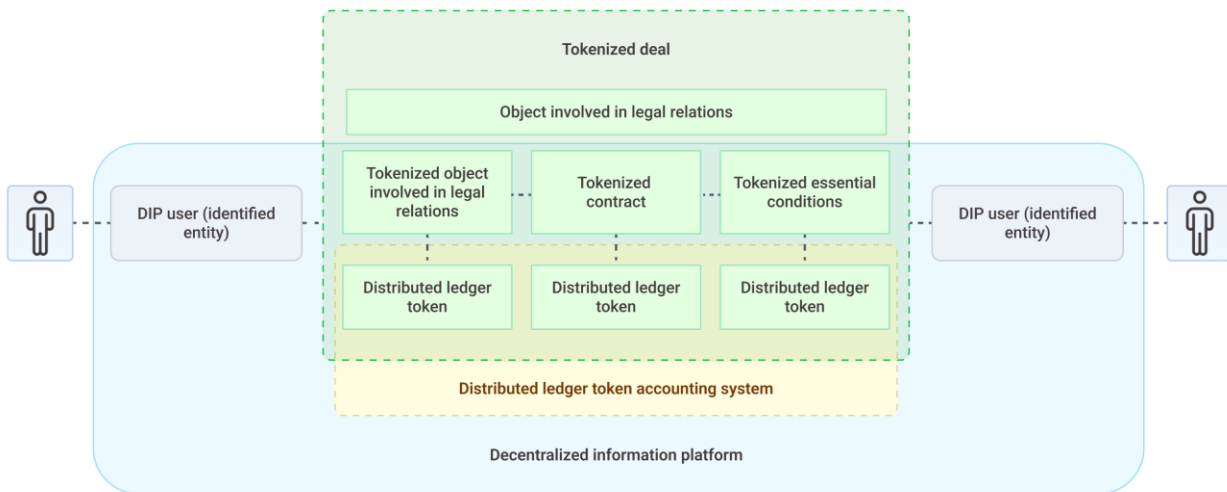


Fig. 4. General scheme of a tokenized deal

\* Source: author's development.

In general, it means that the distributed ledger as a component of the decentralized information platform and distributed ledger token accounting system, in fact, act as a processing center for deals using tokenized assets.

A practical component of using tokenized deals is very large since all market relations between economic agents are deals. Therefore, a tokenized asset use allows:

- optimizing a deal;
- ensuring software control over fulfillment of contract conditions;
- increasing economic efficiency due to the emergence of new business models based on tokenized assets as well as reducing time and transaction costs;
- ensuring high trust between counterparties and transparent legal relations, etc.

Thus, taking into account an analysis of a deal as a foundation for all market relations between economic agents, the information and applied nature of the tokenized asset has been revealed allowing one to distinguish its types at the applied level based on the feature “original asset underlying the tokenized asset”:

- 1) tokenized document (contract);
- 2) tokenized resource (object involved in legal relations);
- 3) tokenized deal.

Taking into account a wide range of a practical component of using various tokenized assets in economic relations at both the common and macroeconomic levels, a potentially very important role of backed tokenized assets in the market infrastructure development can be foreseen (Table 1).

*Table 1*

**Potential impact of tokenized assets  
on the renewal and development of the market infrastructure**

Type of tokenized asset	Main purpose of tokenized asset	Key essential feature or factor affecting economic relations	Subjectively assessed form and power of tokenized asset impact on traditional relations	Prospective areas of tokenized asset application
1.Tokenized document (contract)	Legally significant authentication of documents and paperless document workflow	<ul style="list-style-type: none"> <li>• technological support for identification of entities involved in legal relations;</li> <li>• guarantee of a constant and valid document (contract)</li> </ul>	<ul style="list-style-type: none"> <li>• strengthening trust in deals in the digital environment;</li> <li>• deep modernization of electronic document workflow;</li> <li>• increasing the share of electronic deals</li> </ul>	<ul style="list-style-type: none"> <li>• digital commerce;</li> <li>• corporate and state document workflow;</li> <li>• voting (will expression) systems;</li> <li>• digital identification;</li> <li>• organization of business activities of enterprises (databases and ERP accounting)</li> </ul>
2.Tokenized resource (object involved in legal relations)	Management of access to the object involved in legal relations through the decentralized information platform interface	<ul style="list-style-type: none"> <li>• technological support for identification of objects involved in legal relations;</li> <li>• guarantee of constant and valid information on the object involved in legal relations;</li> <li>• management of access to the object involved in legal relations (information on the object involved in legal relations)</li> </ul>	<ul style="list-style-type: none"> <li>• improvement of fighting piracy of protection of intellectual property rights;</li> <li>• increasing economic feasibility and efficiency of monetization for authors of objects of intellectual property rights (audio materials, works, scientific papers, etc.) and reducing the cost of access to them;</li> </ul>	<ul style="list-style-type: none"> <li>• digital commerce;</li> <li>• scientific publishing houses;</li> <li>• management of objects of intellectual property rights;</li> <li>• Internet of things;</li> <li>• marketplaces in the agricultural sector (for example, Agrobon)</li> </ul>

			<ul style="list-style-type: none"> <li>• development of Web 3.0 industry tools</li> </ul>	
3.Tokenized deal	A new method of legally significant certification of deals	<ul style="list-style-type: none"> <li>• technological support for identification of entities and objects involved in legal relations;</li> <li>• registration of deals using a distributed ledger token transaction;</li> <li>• using a distributed ledger token to manage rights under the contract</li> </ul>	<ul style="list-style-type: none"> <li>• optimization of deal procedures;</li> <li>• automation of deals due to the integration of software control over fulfillment of the concluded contract conditions;</li> <li>• development of new business models based on tokenized assets;</li> <li>• increasing the efficiency of economic relations by reducing time and transaction costs;</li> <li>• more transparent legal relations in the digital environment and increase in the number of such deals</li> </ul>	All areas of social and economic relations based on legally significant deals (civil law/private law)

\* Source: author's development.

Based on the above (Table 1) list of types of tokenized assets (namely, tokenized document (contract), tokenized resource (object involved in legal relations), tokenized deal) and listed properties of tokenized assets [7], it is necessary to determine something new or useful provided by properties and parameters of the tokenized asset for regulating social and market relations. As is known, each property or unique parameter of a certain object necessarily includes some functionality for operation. In the case of a tokenized asset, it implies (a) managerial consequences (Table 2) for regulating market relations in the national and even international economy through the renewal of relations and roles of market infrastructure participants as well as (b) examples or prospective areas of application of new opportunities (Table 2).

**New opportunities for regulating market relations using tokenized assets,  
which are consequences of properties and parameters of tokenized assets**

Property or parameter of tokenized assets	Useful consequences for regulating market relations in the economy	Examples or areas of application
1. Distributed ledger token data	<ul style="list-style-type: none"> <li>• a token becomes a tool for transferring rights and obligations of the parties to the agreement;</li> <li>• a token becomes an object involved in relations;</li> <li>• a token becomes “a key” for using opportunities of the blockchain technology</li> </ul>	Instant conclusion of online agreements and control over their execution using smart contracts
2. Circulation in the distributed ledger token accounting system	Circulation takes on properties of maximum security from unauthorized duplication and modification due to the blockchain technology properties	Assessment of qualities of borrowers within the non-banking fintech industry, and not by commercial banks
3. Original asset	<ul style="list-style-type: none"> <li>• in case of implementation, financial and management accounting can be organized at the enterprise;</li> <li>• involving tokenized assets in civil circulation</li> </ul>	<ul style="list-style-type: none"> <li>• placing tokenized assets on the enterprise’s balance sheet;</li> <li>• using as a pledge, etc.</li> </ul>
4. Identification of the object involved in legal relations using a tokenized resource	A new way to confirm the result of intellectual property created by the owner of the object involved in legal relations in the scope of rights to the object involved in legal relations he/she has	Implementation of mutual obligations between the debtor and the creditor
5. Use of a tokenized document	<ul style="list-style-type: none"> <li>• a new philosophy of perception of means of exchange and payment (but not accumulation) without reference to the state;</li> <li>• a clear connection between the digital and physical world</li> </ul>	Renewed document workflow in a digital trusted environment
6. Storage of all tokenized deal components in the decentralized information platform	<ul style="list-style-type: none"> <li>• protected storage;</li> <li>• possible state recognition of the DIP data for organizing public services;</li> <li>• avoiding the anarchism and permissiveness inherent in the circulation of all cryptoassets due to clear, accurate and automatic accounting in the DIP;</li> <li>• restoring particularly scarce trust in relevant areas</li> </ul>	<ul style="list-style-type: none"> <li>• thus, the DIP becomes a very desirable way of monitoring property transactions for taxation and certification (instead of a notary);</li> <li>• a new impetus for the development of security trading with advanced digitalization and high requirements for trust. For example, a function of a custodian of securities is entirely based on trust;</li> </ul>

		<ul style="list-style-type: none"> <li>• central bank digital currency accounting in a large DIP will ensure the demand for digital currency among foreign buyers for settlements</li> </ul>
7. Divisibility of accounting units	<ul style="list-style-type: none"> <li>• an ability of the owner to independently create new tokenized assets based on the scope of rights to the tokenized asset, to almost infinitesimal shares that will be recorded in the blockchain-based DIP;</li> <li>• possible implementation and support for micro-DIPs created according to the principle of fractality (self-similarity) in the “parent” DIP;</li> <li>• all identified participants can create their own services and support them using their own services and existing property rights to a certain asset (as property) in the “parent” DIP</li> </ul>	<ul style="list-style-type: none"> <li>• development of self-employment in the digital environment as a counterbalance to unemployment;</li> <li>• reducing the tax base for the state is an incentive for a deep reform of the state governance system and public service system</li> </ul>

\* Source: author’s development.

Particular attention should be paid to the seventh property — divisibility of accounting units that gives rise to a derivative, but new (as for practice) possibility in the decentralized information platform, such as implementation and support for micro-DIPs created according to the principle of fractality (self-similarity) in the “parent” DIP (see Table 2). As such, an essential phenomenon of fractal micro-DIPs (according to [8]):

firstly, cannot be outside the DIP as it is a direct consequence of the DIP and in relation to the tokenized asset this phenomenon is derived from the use in the DIP;

secondly, is most revealed precisely in the decentralized information platform with tokenized assets that are registered in this platform;

thirdly, a distributed ledger token acts as a means and object of economic management.

Therefore, the above analysis of properties of tokenized assets and their information and applied aspect allows summarizing new opportunities for regulating market relations using tokenized assets, which are consequences of properties and parameters of tokenized assets (see Table 2).

Further, based on the generalization in Table 2, it is possible to synthesize five quite specific and actually existing (as of 2022–2023) levels of formation of a new economic potential of tokenized assets for the market infrastructure regulation and development (Figure 5).

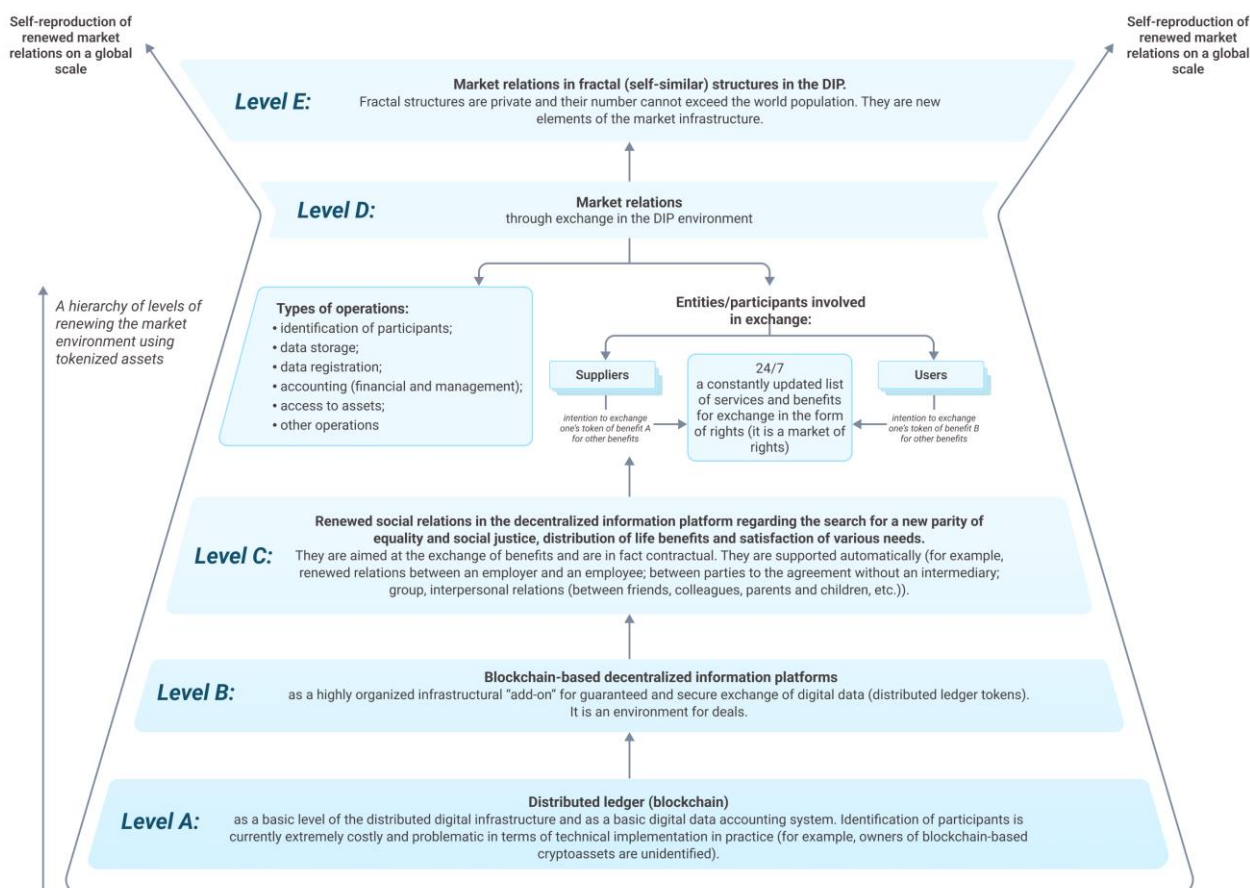


Fig. 5. Levels of formation of a new economic potential of tokenized assets for the market infrastructure development

\* Source: author's development based on [5; 7].

The hierarchy of these levels indicates the following:

1) how the blockchain technology creates a digital information environment (ecosystems in the decentralized information platform) and it, in turn, can change social and market relations in modern society of the 21st century due to a significant reduction in the number of intermediaries in the economy, changing roles of entities involved in economic relations (i.e. participants), namely "supplier" and "user";

2) how renewed market relations can be reproduced in self-similar (fractal) structures, so-called micro-DIPs, in the “parent” decentralized information platform.

***Conclusions and prospects for further research.*** The above analysis allows drawing the following aggregated conclusions.

1. Distributed ledger tools and especially the most promising type of distributed ledger virtual asset, such as a tokenized asset, can drive the market infrastructure modernization. It will be a new and additional means for addressing global wealth inequality using tokenized assets. Its “key” is to create new professional jobs in the ecosystems of decentralized information platforms. The most expected promising areas, especially widespread digital commerce, management of objects of intellectual property rights, agricultural sector at the level of micro and small farms, pave the way for significant, almost radical transformations in the composition, structure and number of participants in the market infrastructure and economic relations on the markets. In general, it indicates the prospect of revising the existing order of organizing market relations towards their digital “reformatting” if the market law of supply and demand is ensured according to the neoclassical economic paradigm.

2. The highest level of formation of the economic potential of tokenized assets for the market infrastructure development in terms of coverage, technological and social complexity is the level of market relations that can be seen within and between fractal (self-similar) structures in DIPs. It can include billions of identified (verified) users around the world organized by means and rules of a decentralized information platform, in particular, when contacting and providing services to each other (the peer-to-peer principle). The main and fundamental technical means for this new market infrastructure organization are backed distributed ledger tokens or tokenized assets, namely tokenized contracts, tokenized resources and tokenized deals. They will form a complex multidimensional global network of decentralized autonomous organizations (DAOs) with fully verified users along with a secure environment for their circulation — a decentralized information platform.

3. Based on the information and applied nature of tokenized assets and four standard components of a deal (contract, entities and objects involved as well as essential

conditions of the contract), the author proposed three types of tokenized assets based on the feature “original asset underlying the tokenized asset”, namely: (a) tokenized document, (b) tokenized resource and (c) tokenized deal. Together they universally cover all types of original (underlying) assets in legal civil and economic circulation in almost any country in the world. Having different functional purposes, these three types of tokenized assets along with a digital ecosystem of services potentially fulfill many functions of market intermediaries in the modern market infrastructure: functions of a notary, automatic accounting, sales agent with appropriate work motivation due to a percentage of the deal, registrar, holder (custodian), etc. Such tokenized assets can make a significant contribution to the market infrastructure development only in a decentralized information platform with its own strategic and ambitious development vision and implemented reliable digital services. Similar decentralized information platforms with corresponding digital ecosystems already exist and will continue to develop.

The author’s subsequent research will be devoted to the disclosure of Figure 5 with a focus on the justification and development of a scientific approach to renewal of participants in the market infrastructure, economic and social relations between them in the platform being a phenomenon with a daily growing number of followers in the world.

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