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CONTRACT LAW 2.0: «SMART» CONTRACTS AS THE BEGINNING OF THE END OF CLASSIC CONTRACT LAW

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CONTRACT LAW 2.0: «SMART» CONTRACTS AS THE BEGINNING OF THE END OF CLASSIC CONTRACT LAW

The paper analyzes legal issues associated with application of existing contract law provisions to so-called Smart contracts, defined in the paper as "agreements existing in the form of software code implemented on the Blockchain platform, which ensures autonomy and self-executive nature of Smart contract terms based on predetermined set of factors". The paper consists of several sections. In the first section, the paper outlines peculiarities of Blockchain technology as currently implemented in Bitcoin cryptocurrency and which forms the core of Smart contracts. In the second section, the main characteristic features of Smart contracts are described. Finally, the paper outlines key tensions between classic contract law and Smart contracts.. The conclusion section sets the core question for analysis of the perspectives of implementation of this technology by governments: "How to align the powers of the government with Blockchain if there is no central authority but only distributed technologies". The author suggests two solutions, which are not optimal: 1) providing the state authorities with the status of a Superuser with extra powers and 2) relying on traditional remedies and enforcement practices, by pursuing specific individuals – parties to Smart contract - in offline mode. It is emphasized that those jurisdictions, which have the most Blockchain-friendly regulations will have competitive advantage in attraction of new innovative business models and companies willing to exploit them in a legal way.

Key words: contract, obligation, Blockchain, Bitcoin, Smart contract.

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Day by day, however, the machines are gaining ground upon us;
day by day we are becoming more subservient to them;
more men are daily bound down as slaves to tend them,
more men are daily devoting the energies
of their whole lives to the development of mechanical life.
The upshot is simply a question of time,
but that the time will come when the machines
will hold the real supremacy over the world and its inhabitants
is what no person of a truly philosophic mind can for a moment question.
Samuel Butler, 1863

The future is already here — it's just not very evenly distributed.

William Gibson, 1993

Introduction

The beginning of the XXI century revealed multiple innovative technologies which produced substantial impact on the new data-driven economy, the most notable of which are: Cloud Computing, Big Data, Internet of Things, Augmented Reality and Blockchain. The latter technology, initially introduced as a technological backbone of cryptocurrency Bitcoin, started to have significance in its own. Governments and companies all over the world are puzzling over the possible implementation of Blockchain technologies in many areas of life, not associated with usage of cryptocurrency. One of most promising areas of implementation of Blockchain technology is using it for creating fully automated contracts – agreements, which are performed without human involvement. Such agreements in IT-environment are frequently called as "Smart" contracts.

I. What is Blockchain?

This is, possibly, the first question, which the person making a deep dive in "Smart" contracts set of issues faces. In order to answer it, one has to understand the origin of this technology which is inseparably linked with Bitcoin cryptocurrency, forming the core of its technological infrastructure.

Bitcoin was developed by an unidentified programmer, or group of programmers, under the name of Satoshi Nakamoto, which is indicated as an author of White paper describing the

basics of functioning of Bitcoin[2]. In the most general terms, Bitcoin can be described as a decentralized, open-source software based peer-to-peer electronic currency. The key features of Bitcoin can be summarized as follows:

1) **Decentralized nature**. Bitcoin does not have a centralized emission center or any trusted central authority: maintenance of the Bitcoin transactions is performed by a network of communicating nodes running special software. From a technical perspective, Bitcoin as a currency unit is nothing more than a computer file, created based on special algorithm processed on computing power belonging to the Bitcoin community members. Bitcoin protocol developers also don't have control over Bitcoin-related transactions: since its code is distributed on the terms of MIT open source license, it is available for inspection for any interested person and modifications, which can become a standard only if accepted by the majority of the community.

2) **Anonymous nature.** One can use Bitcoin without any special registration or identification procedure. It is sufficient to install special wallet application to initiate transactions with Bitcoin. Each wallet consists of Bitcoin units, public key and private key. Private key is used for transfer of Bitcoin unit by its owner to another user's wallet. Without knowledge of the private key, the transaction cannot be signed and Bitcoin unit cannot be spent[3]. Public key is used by other persons to send Bitcoin units to this wallet and is used by Bitcoin network for verification of transactions. Thus, Bitcoin is a pseudonymous currency, meaning that funds are not tied to real-world entities but rather to specialized addresses. Their owners are not explicitly identified, but all transactions on the Blockchain are public.

3) **Mathematic algorithm as a basis of Bitcoin value.** There is no specific intrinsic value in Bitcoin, similar to commodities with limited availability like gold, neither there is authority of the government like in fiat money behind it. However, it does not mean that Bitcoin does not have anything backing up its value. It is backed by mathematics, cryptography, and computer code. Bitcoin units are created during the process known as "mining". Each person, who installed specialized software, may "mine" Bitcoin unit as a reward for solving a complex mathematical problem, associated with verification of transactions performed with Bitcoins. The complexity of such problems is growing together with the amount of transactions performed in Bitcoin network. In other words, emission of new Bitcoin is a result

[2] Satoshi Nakamoto. *Bitcoin: A Peer-to-Peer Electronic Cash System*. P. 3. < www.bitcoin.org>
[3] From technical perspective, it is possible to state that ownership of Bitcoin unit amounts to knowledge of the private key.

of performance of computing activities to the benefit of all the Bitcoin community. Overall number of Bitcoins is defined by the protocol and amounts to 21 million bitcoins. Since computational power is a valuable and limited resource, having intrinsic costs (e.g. for hardware involved and electricity), and Bitcoin has limited availability, which is ensured by mathematic algorithms, it is possible to claim that Bitcoin has some value behind it.

4) **Absence of single administrator of transactions.** It is a well-known fact that electronic money is subject to the risk of double-spending[4]. Unlike physical coins, electronic money like any computer data can be duplicated and thus be used more than once. Traditional electronic money systems prevent double-spending by having a centralized trusted administrator that follows established process for authorizing each transaction. The problem with this solution is that the fate of the entire money system depends on the company running administrative function, with every transaction having to go through them, just like a bank. Bitcoin resolves double-spending problem by using a peer-to-peer network and this is where Blockchain technology plays the key role. All the transactions ever performed with all Bitcoin units are included in publicly available database. Information about new transaction with Bitcoin is distributed through the network, is verified by miners and then is fixed with indication of the time it was made (timestamp) and unique number of Bitcoin unit. Thus, it is possible to trace all the history of transactions with each particular Bitcoin unit in the database of all the transactions with Bitcoin – Blockchain.

5) **Resilience to data manipulations from outside.** Cryptography used in the process of creating records on Bitcoin-related transactions in Blockchain database prevents tampering with the content of such records ensuring their perpetual nature. Whenever two people exchange Bitcoin units, an encrypted record of the transaction is sent out to all other nodes in the Bitcoin network. The other nodes verify the transaction by performing complex cryptographic calculations on the data in the record («mining»), and notify one another each time a new "block" of transactions is confirmed as legitimate. When a majority of the nodes agree that a block passes review, they all add it to the Blockchain database and use the updated version as a cryptographic basis for encrypting and verifying future transactions. Each block is guaranteed to come after the previous block chronologically because the previous block's hash would otherwise not be known. Each block is also

[4] See, e.g. Schneider G 2008, *Electronic Commerce*. 8th ed, Cengage Learning, P. 522 ff.

computationally impractical to modify once it has been in the chain for a while because every block after it would also have to be regenerated. Thus, it is not possible to rewrite information about certain transaction once it is included in Blockchain: such information will be rejected by the network, unless the intruder possesses more than 50% of the overall computational power of the Bitcoin network[5]. As a result all the members of Bitcoin community have a single version of "truth", which is irreversible. Each participant to the transaction has a copy of the Blockchain database and it is synchronized with each other by using specialized algorithm. All this creates an unprecedented level of trust between the users of Bitcoin, where Blockchain is the core element facilitating such trust.

Most of the features of Bitcoin cryptocurrency are facilitated by Blockchain technology. However, potential of this technology goes far beyond facilitation of decentralized electronic payments. To name a few examples from other spheres, there are existing prototypes of solutions, built on Blockchain technology facilitating electronic voting in the sphere of corporate governance. Russian national payment depositary created a distributed database of votes, protected by cryptographic measures. Copies of such database are stored by all the shareholders and, as developers claim, cannot be falsified; regulators or auditors may receive all the necessary information for performance of supervision function simply by connecting to the database[6].

There are potential applications for Blockchain technology within the real estate industry. Once information on the title to the real estate is in the Blockchain, the owner can transfer property without any further interaction with the registry. Moving forward, each new transfer of property would build-out the chain of title on the Blockchain. Blockchain-based land registration system (in conjunction with associated business process changes) has the potential to decrease insurance premiums[7].

Finally, Blockchain may be used for creating a new contracting environment, where the contracts are performed or even both concluded and performed automatically, without human involvement or at least with substantially minimized involvement.

Based on above Blockchain can be defined a decentralized distributed database of all verified transactions that take place across the P2P-network system operating on cryptographic algorithms. It's value can be characterized by the following two core enablers: 1) it allows to transfer digital asset (or virtual representation of physical offline asset) in a way that 2)

[5] Swanson T, 2014, *Great Chain of Numbers*, P. 18. < https://goo.gl/lBDVE5>

[6] CNews, April 29, 2016, *NSD Tested a Blockchain-Based E-Proxy Voting Prototype*, <https://www.nsd.ru/en/press/pubs/index.php?id36=629089>

[7] Spielman A 2016, *Blockchain: Digitally Rebuilding the Real Estate Industry*, <http://dci.mit.edu/assets/papers/spielman_thesis.pdf >

facilitates disintermediation of the economy by allowing to maintain truthful records about the asset owners without involvement of a trusted intermediary (registrar, financial institution, notary, etc.). Blockchain ensures equal access to transparent and trustworthy information. Not surprising, that this potential is already recognized. According to World Economic Forum report, by 2027 around 10% of the world's GDP will be concentrated in Blockchain based technologies[8].

Now it is time to switch to analysis of «Smart» contracts as one of the most promising implementation of Blockchain technology.

II. Definition of «Smart» contract and its key features

Contract law is one of the most dynamically developed area of law: it constantly evolves, addressing appearance of new business models and technologies. Based on the analysis of the evolution of the methods of contracting and the shape of freedom of contract principle, it is possible to argue that each type of society has its own predominant form of contracting[9].

Agrarian economics was mostly dominated by individually agreed contracts where the parties to the contract negotiated "at arms length" all its terms. Industrial society is dominated by more simplified form of contracting: standardized terms, which allowed mass-market contracting with minimized human involvement in its negotiation process and lower transaction costs. Information society will tend to go further by minimizing human involvement not only in defining the contractual terms but also in their enforcement. Besides, new types of agreements may be also concluded without direct human involvement, by electronic agents. "Smart" contracts are a good example of the development of contracting procedure in this direction.

There is no universally agreed definition of "Smart" contract, what is not a surprise, both due to the very novel nature of this phenomena, and due to its complex technological basis. According to the most simple definition, Smart contract is an agreement whose execution is automated. According to Nick Szabo, one of the pioneers in analysis of automated self-enforced agreements, Smart contract is a computerized transaction algorithm, which performs the terms of the contract[10]. However, this definition may hardly catch the difference of "Smart" contracts from some already well-known contractual constructs implementing automated performance, e.g. vending machines.

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[8] 'Deep Shift. Technology Tipping Points and Societal Impact', World Economic Forum, Survey Report, 2015, p. 24.

[9] Using the level of development of contract law as a litmus paper for assessing the degree of maturity of the society has a long tradition ascending to the famous statement by Henry Meine according to which civilization's progress can be generally determined as a movement from "status to contract". See: Maine H 1920, *Ancient Law: Its Connection with the Early History of Society and its Relation to Modern Ideas*, London, p. 151.

[10] Szabo N 1994, *Smart contracts in Essays on Smart Contracts, Commercial Controls and Security* <http://szabo.best.vwh.net/smart.contracts.html >

Vending machines are defined as self-contained automatic machines that dispense goods or provide services when coins are inserted or payment in other forms (e-cash, credit card) is made. Vending machines are programed with the certain rules that could be defined in a contract, and perform such rules.

If there is no principle difference between vending machines and Smart contracts, then we will have to admit, that Smart contracts are almost as old as Roman law itself. The earliest known reference to a vending machine is in the work of Hero of Alexandria, a first-century AD Greek engineer, and mathematician. Hero Ctesibius (sometimes referred to as Heron) of Alexandria documented the first vending machine in the published journal entitled *Pneumatika* in 62 A.D. His machine accepted a coin and then dispensed holy water. When a-five-Drachma piece deposited in, it was exchanged for a small supply of holy water in Egyptian temples. The lever opened a valve which let some water flow out. The pan continued to tilt with the weight of the coin until it fell off, at which point a counterweight snapped the lever up and turned off the valve[11]. So, a contemporary vending machine is based on a piece of technology that's nearly two thousand years old.

Acknowledging the wide-known statement that there is nothing new under the sun, it is still necessary to analyze, whether there is something principally new in Smart contracts comparing to automated vending machine or not. The degree of novelty of Smart contracts and presence of certain special features in it becomes especially relevant if we turn to practices used in exchange markets, where so-called automated trading systems is widely used. For example in foreign exchange markets, trades are frequently executed not by the trader himself, but by a computer system based on a trading strategy implemented as a program run by the computer system. As of 2014, more than 75 percent of the stock shares traded on United States exchanges originate from automated trading system orders[12]. So, automated contracts per se are not something new: they are widely used in many spheres for a long period of time already. So what is so special with Smart contract then?

For this it is worthy to refer to another definition of Smart contract provided by Gideon Greenspan: "A smart contract is a piece of code which is stored on an Blockchain, triggered by Blockchain transactions, and which reads and writes data in that Blockchain's database[13] ". This definition is more concrete, as it makes an emphasis on the Blockchain technology as one of the core features of Smart contract.

[11] Segrave K 1944 *Vending Machines: An American Social History*, McFarland and Company, Inc., Publishers, p. 3
[12] Levine D 2013, 'A day in the quiet life of a NYSE floor trader',*Fortune*, 29 May, <http://fortune.com/2013/05/29/a-day-in-the-quiet-life-of-a-nyse-floor-trader/>
[13] Greenspan G 2016 'Beware of the Impossible Smart Contract', *Blockchain news*, 12 April, < http://www.the-blockchain.com/2016/04/12/beware-of-the-impossible-smart-contract>

However, the question is: whether Blockchain has certain legal implications on contracting process, which would make it significant for characterization of Smart contract, or it is only a fashionable technology, representing interest mostly for IT-specialists. From the author's point of view, Blockchain can be regarded as a "paradigm-shifter" in the sphere of contracting: *it allows to automate the process of performance contractual process of both parties*. Old-school vending machines automate performance only of one party, requiring at least some personal involvement on the other side (e.g. coin insertion or application of a banking card). When both parties' performance can be fully automated it creates a new quality of the contract, even triggering a question, whether there is still a contract in a legal sense and not some other kind of phenomena. Another peculiarity of Blockchain-based contracts is that it allows not only to automate performance of a contract, but also a process of its conclusion: it can be concluded be electronic agents, employed by the parties.

In some cases, a contracting party can be represented by the so-called Decentralized Autonomous Organization (DAO).[14] This concept has not yet received universally-recognized definition. According to one of the positions, DAO is nothing more than a set of long lasting "Smart" contracts as opposed to a regular "Smart contract" having specific purposes and coming to an end once they are achived. The organizational theorist Arthur Stinchcombe once wrote that contracts are merely organizations in miniature, and by extension all organizations are just complexes of contracts. Firms are created using a series of contractual agreements, ranging from employment contracts and employee benefits, to deals with vendors and suppliers and obligations to its customers, to building leases and sales & purchases of equipment. Traditionally, these contractual obligations are quite costly because they need to be enforced externally by society in the form of a trusted legal system and through legal enforcement. Courts, lawyers, judges and investigators all form this system of contract enforcement. With a blockchain-based «Smart» contract, however, much of these costs are greatly reduced or eliminated. This promises to make blockchain-based organizations more efficient, cost-effective, and competitive compared to traditional firms in the marketplace.

All the above illustrates that "Smart" contracts go far beyond the existing models of contracting process and represent a new paradigm of interaction in a cyberspace. To illustrate this thesis it is necessary to provide some examples of potential application of "Smart" contracts in real life.

"Smart" contracts allow to create pools of resources and to allocate them according to agreed criteria, what can be especially relevant for crowdfunding activities or for insurance-type

[14] Hayes A 2016, 'Decentralized Autonomous Organizations: IoT Today', *Investopedia*, February 29, <http://www.investopedia.com/articles/investing/022916/decentralized-autonomous-organizations-iot-today.asp>

of contracts. To bring some examples, Smart contract may track the amount of funds submitted to the crowdfunding project, and once it exceeds the necessary total, such amount is transferred to beneficiary. Otherwise, funds are returned back to the donors.

Another example. A group of farmers may agree to create a pool of resources as an insurance against the drought or flood or other natural disaster. Once such a disaster occurs, machine verifies it according to the specified procedure (e.g. by checking the weather or news in predesignated sources) and allocates resources. Needless to say, that Smart contract provides ultimate degree of transparency and auditability, mitigating the risks associated with intermediary's decision-making process and "human factor" as well as with time delays. As an additional "bonus", such payments occur seamlessly across the borders.

But is it possible to claim that Smart contract is still a contract in a meaning attributed to it by contract law? It seems that this is one of the most controversial matters in Smart contracts. Some scholars argue, that Smart contracts are a form of self-help, because no recourse to a court is needed for the machine to execute the agreement[15]. Self-help can be understood as "legally permissible conduct that individuals undertake absent the compulsion of law and without the assistance of a government official in efforts to prevent or remedy a civil wrong"[16]. Such an approach, while having some merits, appears to be too simplistic, depriving Smart contract of deeper analysis within the framework of contract law and setting certain questions, worth of answering.

According to the Russian law, a contract is an agreement between two or more parties, which establishes, amends or terminates civil-law legal relations between them (Article 420 of the Civil Code of the Russian Federation, hereinafter – "CCRF"). This definition is pretty similar to the one, commonly used in Europe ("A contract is an agreement which is intended to give rise to a binding legal relationship or to have some other legal effect. It is a bilateral or multilateral act"[17]).

One of the thesis of this paper is that Smart contract can be regarded as a legally-binding agreement. First of all, it is used to govern relations associated with circulation of certain digital assets, thus intending to govern economic relations between the parties, what is a realm of civil law. Transfer of digital Blockchain-based asset from one person to another one is a typical

[15] Raskin M 2016, *The Law of Smart Contracts*, p. 31, < http://ssrn.com/abstract=2842258>

[16] Douglas I B et al. 1984, *SPECIAL PROJECT: Self-Help: Extrajudicial Rights, Privileges and Remedies in Contemporary American Society*, 37 Vand. L. Rev. 845, 850. Similar understanding of self-help is shared in Russian law.

[17] II. – 1:101 (1) of the Draft of a Common Frame of Reference (DCFR). DCFR is an academic text, one of the functions of which is The function to sharpen awareness of the existence of a European private law and also (via the comparative notes that will appear in the full edition) to demonstrate the relatively small number of cases in which the different legal systems produce substantially different answers to common problems. The drafters of DCFR claim that "it may furnish the notion of a European private law with a new foundation which increases mutual understanding and promotes collective deliberation on private law in Europe". See: Study Group on a European Civil Code 2009, *Draft Common Frame of Reference*, Outline Edition, Sellier, p. 7.

subject matter of Smart contract and may qualify as a "legal effect", being one of the constitutive elements of a contract.

Secondly, although Smart contract's performance is automated, it still requires the presence of the will of the party to it in order to become effective. Such will is manifested at the moment when an individual decides to enter into such an agreement on the terms specified in advance, or, in case with electronic agents, – when individual decides to use such an agent for conclusion of certain agreements and agrees to be bound by their actions. The person expresses its consent with the terms of the contract and mode of their execution at the moment of conclusion of the contract. Taking into account that such person won't be able to influence the execution of the agreement, once it is entered to, there should be a certain trust in place, which gives rise to a kind of "fiduciary" relations in Smart contract. But in contrast to classic contract where trust is put in the personality of the other party to the contract, in Smart contracts such trust is put in the computer algorithm standing behind the agreement ("trustless trust").

It is also possible to find offer and acceptance in the process of Smart contract formation. If we take an example with crowdfunding Smart contract, its terms are predefined by the beneficiary ("offer") and a person willing to donate to the project by transferring a certain asset to the pool is making an acceptance of that offer by its behavior. Under existing contract law provisions the contract is considered to be concluded in such a case (Article 438 (3) of the CCRF, II- 4:204 DCFR) and may be qualified as a contract of adhesion (Article 428 of the CCRF) or more broadly – a contract concluded on standard terms (Section II – I: 109 DCFR).

Whether or not there is an intent to create legal relations by the party's to the "Smart" contract is a tricky question: it is possible to argue that by entering into a "Smart" contract they have an intention to use alternative regulatory system, not a classic contract law, thus there is no true intent to create legal relations. However, if the *result* is in fact the same in substance to the one, usually regulated by usual contracts - transfer of ownership over certain asset- then it may be argued that the nature of the relations in the core of it are also the same. Besides, "Smart" contracts don't fall into a class of agreements, where legal contracts are not normally made (e.g. social invitations like invitation to dinner or family arrangements (e.g. a promise to wash the dishes).

Finally, the mere fact that the contract is concluded by electronic means does not mean that it is not a contract. The same is true for the contract that exists solely in cyberspace.

Now it is necessary to outline the features of Smart contracts, which could be used for finding its place in the existing contractual concepts. Based on the current understanding of Smart contracts it is possible to enlist the following ones: 1) solely electronic nature; 2) software

implementation; 3) increased certainty; 4) conditional nature; 5) self-enforcement; 6) self-sufficiency.

Let's take a closer look on each of them.

1. **Solely electronic nature**. Classic contracts may exist in various forms, e.g. in oral form or in writing. Of course, the development of e-commerce substantially increased the amount of agreements concluded in electronic forms, the most evident examples of which are various click-wrap agreements. However, even in case of e-commerce contracts, there may be still some classic paperwork required, e.g. invoices, receipts or certificates of delivery, especially when such electronic contracts are covering purchase of offline goods or services. Sometimes, those documents are the only evidence or manifestation of the contract existing in electronic form. In contrast to that, *Smart contracts may exist only in electronic form, it is not possible to use any other form of the contract to them* (e.g. oral or written hardcopy). It is also driven by the specifics of the subject matter of Smart contracts: it may relate to certain digital assets (e.g. cryptocurrency) or digital manifestations of offline assets, title to which is registered in Blockchain. This differs Smart contract from most click-wrap agreements, which also exist in electronic form, but only impose some negative obligations on the user (e.g., not to perform certain activities while using the service or not to object to certain activities performed by the service-provider).

Execution of the terms of "Smart" contract should also be linked to certain electronic events/data. Otherwise, "Smart" contract won't be self-enforceable (see below). All these features predefine solely electronic form of possible existence of Smart contact.

Moreover, "Smart" contract by its nature requires using electronic digital signatures, based on encryption technology. Under the Russian law such signatures due to the presence of cryptography would qualify as "advanced non-qualified signature" and their usage is generally governed by the agreement of the parties using such a signature[18].

2. **Software-implemented**. Code is law, and in Smart contracts computer code is also contractual terms. Thus, contractual terms are manifested in a computer code, what is not generally prohibited based on the "freedom of contract" principle. Therefore, it is possible to argue that each Smart contract by its legal nature is also a computer program in a meaning of IP law[19].

[18] Russian law also recognizes so-called "advanced qualified signature", which is provided by the specialized center accredited by the government authority what attaches the highest legal force to a document signed with such signature and "simple electronic signature" which can be based on a wide range of technologies (sms-codes, passwords) and whose legal force is based on the prior agreement of the parties to use such type of signature in their relations. See: Federal'nyy zakon ot 06.04.2011 N 63-FZ "Ob elektronnoy podpisi" [Federal Law of the Russian Federation No. 63-FZ "On electronic signature" of 04/062011].

[19] Russian definition of computer program is quite similar to the U.S. one. According to Article 1262 of the CCRF, computer program is a set of statements and instructions, to be used by a computer in order to achieve a certain result. Under U.S. Copyright Act, computer program is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result.

Thus, *Smart contract has dual nature in the law: it serves as a "document" governing contractual relations of the parties and it is also object of the IP rights*, representing the valuable object of intellectual activity. Therefore, programming certain Smart contract based on the requirements of the customer can be treated as software development process, while distribution of subsequent rights to "Smart" contract should be performed within the license/assignment of IP rights framework.

To bring an example of how "Smart" contract may look like from a factual perspective, here is an extract from a text of the Smart contract based on the Ethereum platform attached[20].

```
contract token {
    mapping (address => uint) public coinBalanceOf;
    event CoinTransfer(address sender, address receiver, uint amount);

  /* Initializes contract with initial supply tokens to the creator of the contract */
  function token(uint supply) {
        if (supply == 0) supply = 10000;
        coinBalanceOf[msg.sender] = supply;
    }

  /* Very simple trade function */
    function sendCoin(address receiver, uint amount) returns(bool sufficient) {
        if (coinBalanceOf[msg.sender] < amount) return false;
        coinBalanceOf[msg.sender] -= amount;
        coinBalanceOf[receiver] += amount;
        CoinTransfer(msg.sender, receiver, amount);
        return true;
    }
}
```

3. **Increased certainty**. Since Smart contract is having software code in its core, its terms are expressed in one of computer languages, which are rather formal languages in their substance: with strictly defined semantics and syntax[21]. Computer language does not allow discretion in its interpretation by machine. Smart contract terms are interpreted by machine based on Boolean logic[22], in contrast to classic contract, where interpretation of terms is performed by human brain based on subjective criteria and analogous way of thinking. Thus, the precision of programming languages is able to mitigate possible issues associated with unpredictable interpretation of contractual terms by the party to the contract or enforcement agency. Although ambiguity may exist in programming languages, these ambiguities are less than in the real world because there are simply fewer terms that a computer can recognize than a human can recognize. As a result of the described specifics of the Smart contract existing rules on interpretation of the contract do not apply to it: ("Interpretation according to the common intention of the parties event if it differs from the literal meaning of the words or in accordance with the meaning which a

[20] Etherium Blockchain App Platform, 'Create your own crypto-currency with ethereum', https://www.ethereum.org/token
[21] For example, Solidity - the language based on JavaScript - was created as language for Smart Contracts on Ethereum platform.
[22] Boolean logic is a form of algebra in which all values are reduced to either TRUE or FALSE. Boolean logic is especially important for computer science because it fits nicely with the binary numbering system, in which each bit has a value of either 1 or 0.

reasonable person would give to it"[23]). Smart contracts are meant to be stand-alone agreements – not subject to interpretation by outside entities or jurisdictions. The code itself is meant to be the ultimate arbiter of "the deal" it represents.

However, a couple of important points need to be made. First of all, due to technical complexities of Smart contract architecture and necessity to possess advanced programming skills to create such an agreement. And in many cases they will be created by specialized companies based on the request from the client. Due to a separation between the person programing the code and the person intending to use it in its commercial activities, there is a risk of misunderstanding between them with regard to the terms of the future agreement. Ultimately, it is about the differences between implementation and intent, which is aggravated by the huge gap of abstraction between legal language and a programming language. However, it can be argued that such misinterpretations should be within the sphere of responsibility of the person implementing Smart contract and resolved within the existing contractual framework with its contractor. Such errors should not affect external parties, persons that are subsequently accepting the terms of such agreement and become a party to a Smart contract.

Secondly, since it is only the computer code, which regulates the Smart contract, the latter becomes automatically subject to various flaws and bugs, which accompany any computer program. And recent hacking attack on one of the Ethereum's Smart contract is an excellent example: in June 2016 attackers exploited a software vulnerability and draining drain millions of ether — with a theoretical value in the tens of millions of dollars. One wallet identified by community members as a recipient of the apparently stolen funds holds more than 3.5 million ether. At an exchange rate of about $14 a unit, that works out at $47 million[24]. In an open letter to Ethereum community the attacker claimed that he has not done anything illegal, he was only 'making use of this explicitly coded feature as per the smart contract terms'[25]. Leaving the matters of qualification of attacker's actions aside, it is possible to state that Smart contracts are still subject to human's misjudgment and although they are potentially immune to mistakes in legal terminology and drafting, they are still vulnerable to coding errors, what, probably, needs to be addressed by the newly developed rules on interpretation of such contracts.

4. **Conditional nature**. Earlier it was argued that Smart contract is drafted on one of the computer languages. Conditional statements are foundational to computing: computer code is based on statements like "if "x" then "y". Such an approach is in harmony with contractual terms and conditions. As Raskin correctly puts it, the enforcement of a contract is nothing more than

[23] See: II. – 8:101 DCFR; Article 431 of the CCRF
[24] Price R 2016 'Digital currency Ethereum is cratering because of a $50 million hack', *Business Insider*, June 17, <goo.gl/SY90Ks>
[25] Pastebin, 2016, 'An Open Letter', June 18, ,http://pastebin.com/CcGUBgDG>

the running of a circumstance through a conditional statement[26]. Under the Russian law, such an agreement can be qualified either as "conditional transaction" (Article 157 of the CCRF) if all of the terms of the contract are conditioned on a certain event, or a contract with conditional obligation (Article 327.1 of the CCRF), where a contract as such becomes effective at the moment of its conclusion, but execution of some of its terms is conditioned to certain events. Similar provisions are provided in Section III. – I:106 DCFR. In this regard Smart contracts fall within the existing taxonomy of contract law.

5. **Self-enforceability**. Once Smart contract is concluded, its further execution is no longer dependent on the will of its parties or third party, neither it requires any additional approvals or actions from their side. Computer verifies all the conditions, transfers assets and makes entries in the Blockchain database about such transfers. Thus, Smart contract is technically binding for all the parties to it, they are no longer dependent on human intermediary, which is subject to errors and subjective discretion. Subsequent change of circumstances or intent of the party to it is irrelevant. There is no room for opportunistic behavior or "efficient breach"[27]. This feature of Smart contracts create substantial tensions with classic contract law, as will be shown later.

6. Self-sufficiency is closely related to the previous feature of Smart contract – its self-enforcing nature. However, self-sufficiency has a different emphasis. Smart contract does not need any legal institutions to exist: neither enforcement agencies, not the corpus of legal rules, default or mandatory ones to supplement it, like they do with regard to classic contracts in case of their incompleteness. As Russian prime-minister, Dmitry Medvedev stated in its speech on the perspectives of development of law, "Smart Contracts represent new challenge to legal regulation. Systems creating such contracts live by their own rules, beyond the boundaries of law"[28]. Self-sufficiency is especially important in transborder transactions, since it allows not to be dependent on differences in languages, national laws and their interpretation [including various types of geopolitical economic sanctions]: same rules are applicable all over the world.

Based on the above features, it is possible to define **Smart contract as a piece of software code, implemented on Blockchain platform, which ensures self-enforcing and autonomous nature of its terms triggered by conditions defined in advance and applied to Blockchain-titled assets**.

Among the benefits of Smart contracts it is possible to outline their ability to decrease a number transaction costs which accompany regular contracts, e.g. costs associated with ensuring performance of such contract (e.g. litigation costs or costs associated with provision of

[26] Raskin M 2016, *The Law of Smart Contracts*, p. 11, < http://ssrn.com/abstract=2842258>
[27] According to Black's Law Dictionary, efficient breach theory is "the view that a party should be allowed to breach a contract and pay damages, if doing so would be more economically efficient than performing under the contract".
[28] Vystupleniye Dmitriya Medvedeva na plenarnom zasedanii [Speech of Dmitry Medvedev on Plenary Session], Saint-Petersburg International Legal Forum, 18 May 2016.

collaterals). Besides, costs associated with involvement of the intermediary in the process performance of a contract (e.g. bank or insurance organization), are also excluded in Smart contracts due to their disintermediating nature. However, it would not be correct to make a conclusion that Smart contracts are cheaper, than regular ones: infrastructure necessary for implementation of Smart contracts and costs associated with the development ("drafting") of terms of Smart contracts are still rather high.

There are Smart contracts platforms already emerged, which gained popularity and recognition. The most evident example is Ethereum, which is a public Blockchain-based distributed computing platform, featuring smart contract functionality. It provides computing capacity (a decentralized virtual machine), that can execute peer-to-peer contracts using a cryptocurrency called "ether". In contrast to Bitcoin ecosystem, which does not allow exchange of any other object than Bitcoin unit, Ethereum allows to facilitate exchange of virtually any class of assets, which is capable of transfer in Internet environment. Ethereum was initially proposed in late 2013 by Vitalik Buterin, a cryptocurrency researcher and programmer, having Russian origins. This platform is viewed as the most prominent basis for further development of Smart contracts. Today Ethereum is the second-longest and fastest-growing public blockchain (after Bitcoin). It even can be perceived as posing a threat to Uber-like business models[29]. Unlike, "Whereas most technologies tend to automate workers on the periphery doing menial tasks, blockchains automate away the center. Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi drivers work with the customer directly.[30]"

Thus, there is no doubt that this platform will attract further investments and the amount of Smart contracts developed on it will increase. Besides, other similar platforms will appear. All this will definitely provoke further attention to the legal nature of the smart contracts and issues associated with the application of the classic contract law provisions to them.

III. Smart contracts in the context of the present contract law: Issues and challenges.

Smart contracts concept creates lots of concerns and challenges when one tries to apply classic concepts of contract law. Moreover, such challenges have universal nature, going to the core of contract law provisions, which are more or less the same regardless of the jurisdiction. The main problem lies in fact, that Smart contracts are created and are developing in a technical universe "parallel" to legal realm, without a backward glance to any legal considerations, like Internet in its early days. Therefore, computer is indifferent to the fundamental legal principles,

[29] Uber removes the traditional middleman — in case with taxi, the taxi dispatcher — from the buyer/seller equation, allowing each driver to be his own boss and work independently of a central company, replacing it with a new type of middleman - computer application.

[30] Tapscott D, Tapscott A 2016 *Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World*, Penguin Publishing Group, Kindle Edition, p.18

such as lawfulness, fairness, protection of weak party. Instead the principles of certainty and effectiveness prevail. The fact that provisions of Smart contract are enforced solely by technical code leads to the following issues.

1. Smart contract does not create obligations in its legal meaning. The notion of obligation, which originates from Romal law and is a key to the Continental contract law is alien to Smart contract. Insitutes of Justinian contain a famous definition of an obligation ("obligatio" in Latin): "it is a bond created by law in accordance with the laws of our community. This bond we can be compelled to sever by the performance of some act, generally the transfer of some thing"[31]. An obligation is a right, but the term "right" denotes only one side of the relationship, which is embraced by roman term "obligatio". To every right there must be a correlative duty: if A has a right that B shall give him an asset, B must be under a duty to give A the book. The term "obligation" denotes therefore, sometimes the right, sometimes the duty, but more properly it denotes the whole relationship[32].

These ideas survived the centuries and are reflected in a modern contract law. In accordance with the Russian law, "by virtue of an obligation one person (the debtor) has the duty to take for the benefit of another person (the creditor) a defined action, such as: to transfer property, to do work, to pay money, etc., or refrain from a defined action, and the creditor has the right to demand from the debtor the performance of his obligation (Article 307 of the CCRF). One of the key elements of obligation is its 1) orientation in the future and 2) "will" component. Since obligation is a legal bond between two persons, such bond exists to the extent that certain action or inaction has to be performed in the future[33] and the debtor has a certain discretion to perform or not to perform it. If nothing depends on the will of the debtor then he is under no obligation to the creditor, since there can be no liability for breach of such an "obligation", it is discharged on force majeure basis.

In order to illustrate this thesis, it is possible to highlight the difference between Smart contracts and contracts with vending machines. In the latter case, although performance is automated, the seller – owner of the vending machine has the discretion regarding the performance of the contract: he may interfere in the process of functioning of such machine (e.g. by shutting it down) and thus, change the outcome of the deal. In Smart contract it is not possible for a party to it to change the outcome by shutting down its computer – all the transactions continue to exist and be processed in cyberspace.

[31] "Obligatio est iuris vinculum, quo necessitate adstringimur alicuius solvendae rei secundum nostrae civitatis iura". Inst. iii, 13, pr.
[32] Nicholas B 1962 *An Introduction to Roman Law*, Oxford, p 158.
[33] It is possible to state that essence of a notion of "obligation" in Continental contract law performs similar functions to the notion of "executory" contract in Anglo-American law.

Absence of obligations understood in classic legal sense in Smart contracts leads to conclusion that all the legal regime associated with the notion of "obligations" is not applicable: mode of performance (place and time of performance, performance by third party, etc.), consequences of non-performance, etc. And this follows from the nature of Smart contract as well: once all the provisions are enforced by technical code, there is no necessity in provisions having a purpose to regulate human interactions.

Does all of the above mean that the Smart contract is not a contract because it does not contain any obligations? Such a conclusion is still too simplistic for a number of reasons. First of all, the parties still express their will when enter into a contract and they are bound by the result of their action. Secondly, contract law acknowledges certain types of agreements, which are performed instantaneously at the moment of conclusion ("executed" contracts in Anglo-american law). Probably, it would be more correct to state that the main consequence of conclusion of Smart contract is not an appearance of "obligations" but the resulting self-limitation of certain rights by technical means.

Smart contract does not give rise to legal bond between the parties. Even if there is some kind of "bond", which all the parties to it share, it relates to technical bond of a party with Blockchain platform of Smart contract and such a bond is much more solid than a legal one.

2. Smart contract cannot be breached by a party to it. This follows from its self-enforceability feature and a logical consequence of its "code is law" nature. A party to it cannot breach a contract if circumstances have changed and more profitable alternative to its performance appeared. It is Roman law "pacta sunt servanda" (Latin for "agreements must be kept") in its absolute form. As a result, all established remedies for breach of contract, e.g. damages, penalties (liquidated damages), specific performance are not relevant for Smart contracts, unless they are explicitly included in its code. There is also no need in specific legal instruments, having a purpose to secure an obligation (collaterals). In other words, all remedies and guarantees, which the creditor has in analogue world, do not have any role to play in a digital realm of Smart contracts. There is no need to seek for enforcement of Smart contract by addressing the claims to third party – judiciary or other enforcement agency. And it is one of the main "selling points" of this contractual form. However, as was mentioned before, this feature is to some extent "compensated" by the potential vulnerabilities of the code of Smart contract, opening it to exploit, either by the party to the contract or by a third party.

One disclaimer should be made here, though. It is possible to image a contract, according to which the performance is structured in a way that may still require party's involvement in the process of its completion. For example, relevant amount of cryptocurrency is not

blocked/deposited on a special account till the specified event occurs, but only details of the account are provided and once event occurred, there is a payment order directed to that account and it contains no assets on it. Thus, a contract may be formally breached. Or, let's take another situation – the counter-performance requires transfer of an electronic asset of certain kind (e.g. passcode to a certain database), but such asset is not valid (e.g. the password does not actually work). Again, in such case the question of non-performance of the contract can be raised. However, although such agreements may be automated by using some kind of computer code, they are not Smart contracts. Not any contract performed on a computer language can be regarded as Smart contract, but only based on Blockchain technology, ensuring its self-enforcement nature. The above examples relate to the contract, which are not self-enforceable and still depend on the degree of discretion of the party to it. In such circumstances, it will be not possible to ensure trustworthiness of information in Blockchain, since it may change in a given moment of time. Thus, it is more correct to treat contracts indicated in the above examples as electronic contracts, but not as "Smart" contracts as such, otherwise, the concept of the latter will be so blurred that would loose its separate meaning.

3. Vitiated consent or intent do not have any impact on Smart contract's validity. Whether it was concluded for mistake, as a result of fraudulent misrepresentation, coercion or threats, unfair exploitation of relationship of trust – it is completely irrelevant for its performance in contrast to classic contracts, where such circumstances serve as a basis for court interference in all the legal systems. Moreover, such consideration of such vitiating factors is in contradiction with the main feature of Blockchain-based databases of transactions: their "single version of truth" for everyone. If such factors may serve as a basis for changing the content of such database post factum, it will undermine the trust in Blockchain and depreciate its value. Therefore, in Smart contracts there cannot be a collision between intent and its expression, what really matters is only an expression of intent represented in computer code. Such an approach can be viewed as a triumph of protection of the certainty and market.

Of course, there is some residual possibility to apply relevant provisions on invalidity of contract and its consequences (damages claims, obligation to return everything received under the agreement, etc.). But this will be possible only if the party to the Smart contract is identified and within the jurisdictional reach of the enforcement authority. Anyway, such enforcement actions won't have impact on the content of Blockchain database, unless it is created on different principles than the currently known Blockchain in Bitcoin.

4. Smart contracts are egalitarian by its nature. Thus, Smart contract architecture does not allow to ensure protection of weak parties, e.g. consumers. The whole layer of legal provisions relating to consumer law and unfair contract terms is non-applicable to Smart contract. At the same time, Smart contracts may provide some extra leverage for consumers to protect their interests. Currently consumers don't have any realistic choice as to conclude or not to conclude a contract: they don't have time to read the terms and conditions, and even if they do – they don't understand its terms. Even if an individual understands them, he does not have bargaining power to change them and if he decides to go to another seller – the outcome will be the same. Smart contracts allow using electronic agents for conclusion of the agreement, and potentially they may be programmed in a way allowing them to search favorable terms and even negotiate them within the established boundaries. For example, so-called "snipers" in eBay online auctions allow to select offers based on certain criteria as well as place offers on behalf of the user with a certain parameters[34]. It is argued that in nearest future Smart contracts will allow consumers to conclude contracts based on terms, pre-established by them, e.g. on certain pricing terms, warranties, absence of monitoring individual's behavior online, etc.[35]. Time will tell, whether it will be the case. However, it is quite possible to expect that at some moment of time Smart contracts will become routine technology, like Internet itself in 90s years of the last century. Usually, certain technology becomes routine when technological elite becomes bored with it, after that it becomes mass market. In any case, it is likely that on initial stages Smart contracts will mostly exist in B2B and C2C sectors, but not in B2C segment of e-commerce.

5. Possibility of illegal smart contracts. Smart contracts are treating legal and illegal subject matter in the same way, what matters is only the possibility to implement such subject matter in a code. There are lots of debates relating to the potential illegal uses of Bitcoin cryptocurrency, which cast shadow on Blockchain technologies as well. In Russia use of Bitcoin is not per se illegal, however, there are warning statements from Central Bank of Russia, and Committee of Financial Monitoring according to which Bitcoin may be used for money laundering schemes and financing of terrorism[36].

Smart contracts can also be used for illegal purposes, for example for procuring hacker services a contract by offering a cryptocurrency reward for hacking a particular website. Ethereum's programming language makes it possible to control the promised funds. It will

[34] eBay Inc, 2013 *eBay Automated Bidding System*, December 30, < http://goo.gl/NPgryF>
[35] Fairfield J 2014 'Smart Contracts, Bitcoin Bots, and Consumer Protection', *Wash. & Lee L. Rev. Online*, vol.71, <http://scholarlycommons.law.wlu.edu/wlulr-online/vol71/iss2/3>
[36] Statement of the Central Bank of Russia "On the usage of cryptocurrencies, including Bitcoin, for performance of transactions" of 27 January 2014; Statement of the Committee of Financial Monitoring of the Russian Federation "On the usage of cryptocurrencies" of 6 February 2014.

release them only to someone who provides proof of having carried out the job, in the form of a cryptographically verifiable string added to the defaced site[37]. Taking into account that Smart contracts may be programed for verification of certain facts based on information available on certain websites, it may verify the fact of completion of certain illegal act (terrorist act, assassination, theft, etc.) and release established remuneration for that act. Although such a contract will be invalid as infringing fundamental principles of legal order (Article 169 of the CCRF, II. – 7:301 DCFR), it will still be executed by program code. The only thing, which the law may oppose is to try to deanonymize and to pursue the individuals involved in the transaction in real life.

6. **Autonomous nature of Smart contracts**. Strictly speaking, Smart contracts don't have a need in a legal system to exist: they may operate without any overarching legal framework. De facto, they represent a technological alternative to the whole legal system. Apart from conclusions already mentioned above, it means that there is no need in conflict of laws provisions, since there are no collisions of various legal systems. Mathematics is universal human language. Thus, Smart contracts are truly transnational and executed uniformly regardless of the differences in national laws. It is a perfect example of new type of regulator governing relations in cyberspace – Reidelberg's lex informatica[38] or Lessig's "code is law"[39]

IV. Conclusion: The ultimate question of Blockchain and Smart contracts.

In The Hitchhiker's Guide to the Galaxy by Douglas Adams, the was an "Ultimate Question of Life, the Universe, and Everything", the answer to which was being calculated by the supercomputer "Deep Thought" over a period of 7.5 million years. The resulting answer, however, was pretty disappointing to most people.

While the above analysis showed that although it is possible to squeeze Smart contracts in Analysis of Blockchain technology and its core features together with established approaches to legal regulation allows to set similar question, which is as global one, as the "ultimate question of life and universe" at least for the destiny of particular technology. Let's call it the ultimate question of "Blockchain and Smart contracts". This question is: "How to align the powers of the government with Blockchain if there is no central authority but only distributed technologies"?

[37] Duggal P 2015, *Blockchain Contracts & Cyberlaw*, Amazon E-Book
[38] Reidenberg J 1997 'Lex Informatica: The Formulation of Information Policy Rules through Technology' *Texas Law Review*, vol. 76, no. 3, p. 55
[39] Lessig L 1999, *Code and Other Laws of Cyberspace*, New York: Basic Books

It is possible to illustrate the essence of the question in the following example. Let's imagine that certain asset is transferred by its owner A to the new owner B and the fact of such transfer is reflected in Blockchain. However, later the owner A claims that B threatened A and thus, the transaction is invalid. The claim succeeds in court and there is a judgment according to which the transaction is considered invalid and the asset belongs to the initial owner A. Thus, there are two realities: the first one is depicted in Blockchain and in accordance to it, the owner is "B", since it is impossible to introduce changes in the content of Blockchain and reverse its data. The second reality is a legal one, sanctioned by the authority of legal system: according to the official judgment the owner is "A". How to align these realities in a way that would be acceptable for all the stakeholders and won't diminish the advantages of new technologies? This is the ultimate question.

Currently, it is possible to suggest two solutions, neither of which seems to be optimal enough.

1) To introduce the concept of "Superuser" for government authorities, which will have a right to modify the content of Blockchain databases in accordance with specified procedure in order to reflect the decisions of state authority;
2) To enforce decisions of state authorities in "offline" mode by pursuing the specific users and forcing them to include changes in Blockchain themselves as well as by using traditional tort claims, unjust enrichment claims, specific performance claims.

The problem with the first solution is that it leads to substantial mutation of Blockchain technology and strips it of the main advantage: resilience to data manipulations from outside and facilitated unique level of trust. If some kind of user of Blockchain technology will have extra powers, including the power to influence the data in it, resulting solution based on such "Blockchain" will be hardly more attractive than traditional databases and registers maintained by the state authorities. All the most attractive and innovative features of Blockchain will be diminished.

The problem with the second solution is that it is associated with time-consuming and inefficient in transborder area instruments from the old era, which don't keep pace with new technologies. De-anonymization and jurisdictional problems are substantially weakening the effectiveness of such an approach and lead to diminishing the sovereign power of the national authorities in cyberspace area.

It is pretty likely that Smart contracts will sooner or later create their own system of dispute resolution. Recent example with the hack attack on Ethereum DAO in June 2016 shows that certain mechanism of reaching a consensus between the parties to Smart contract on certain

unexpected (non-programed) events is necessary. But this won't solve that Ultimate question of Blockchain and Smart contracts, rather will heat it even more, since the legitimacy of such mechanisms and their recognition by the state authority will become at stake.

So it is necessary to state that the Ultimate question of Blockchain and Smart contracts is still waiting for its answer since the current ones are hardly satisfactory for all the stakeholders and for development of these technologies. One thing is evident, however, those jurisdictions, which will have the most Blockchain-friendly regulations will have competitive advantage in attraction of new innovative business models and companies willing to exploit them in a legal way.

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